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Fyfe

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[54] HYDRAULIC SHIFTING SYSTEM FOR RIDER PROPELLED VEHICLE

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[51] Int. Cl.[6] F16H 9/24

[52] U.S. Cl. 474/80; 474/110; 280/238; 280/261

[58] Field of Search 474/70, 80, 101, 474/104, 110; 280/200, 201, 236, 238, 261

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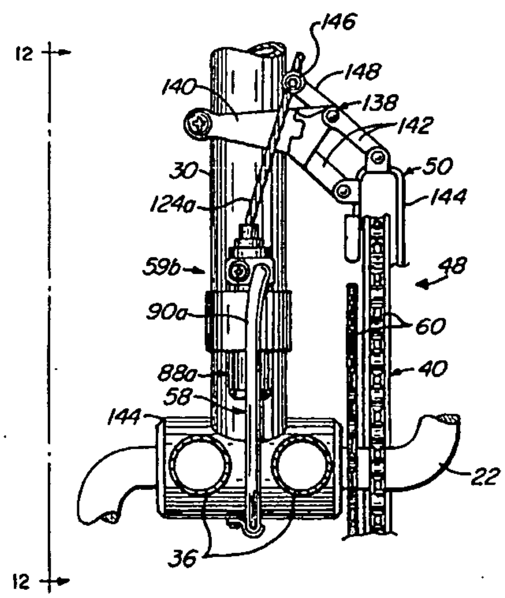
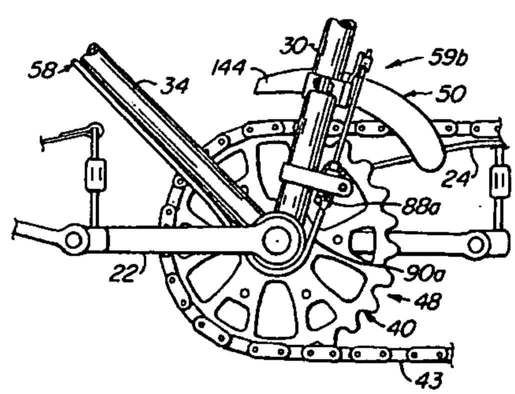
Primary Examiner—Roger J. Schoeppel
Attorney, Agent, or Firm—Boniard I. Brown

[57] ABSTRACT

A shiftable variable ratio sprocket chain drive for rider propelled vehicles, such as bicycles, and for other uses has a shifting mechanism, such as a derailleur mechanism or a gear mechanism, a shifting actuator operable by the rider or user, and a novel hydraulic connector operatively connecting the actuator and the shifting mechanism for hydraulically operating the shifting mechanism to vary the ratio of the drive in response to operation of the actuator.

9 Claims, 6 Drawing Sheets





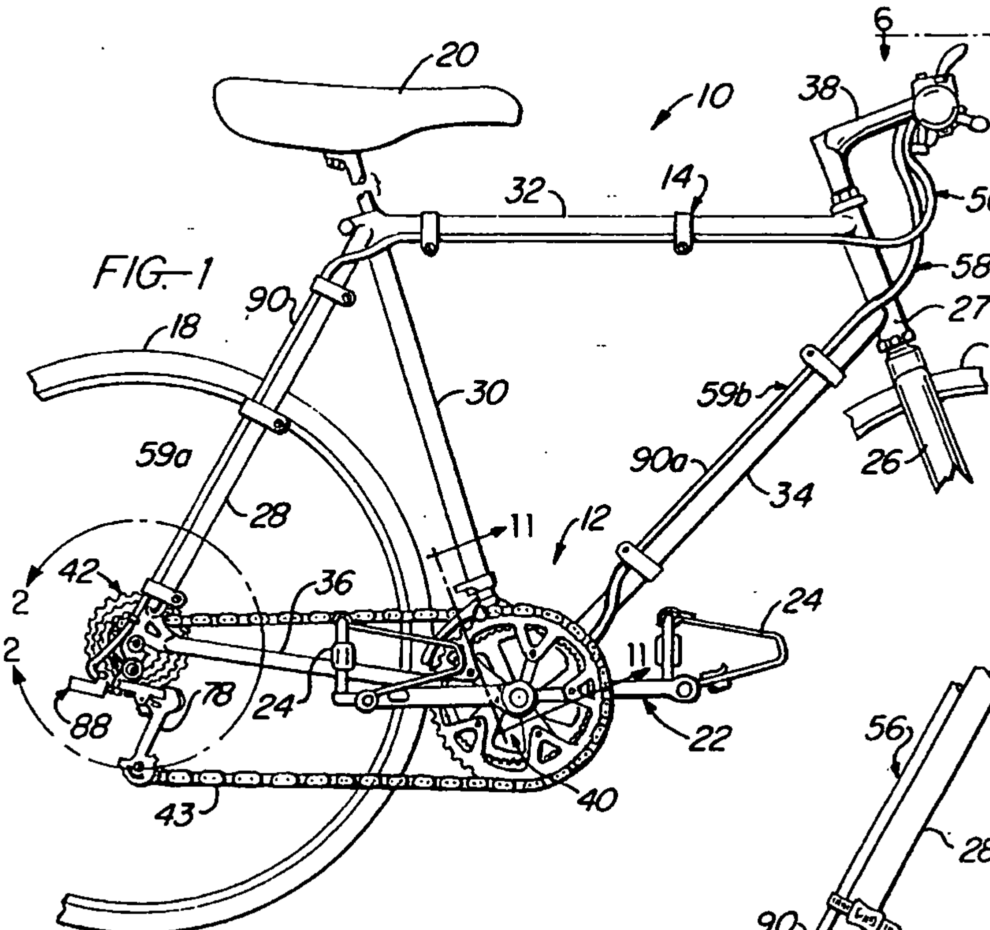


FIG.-1

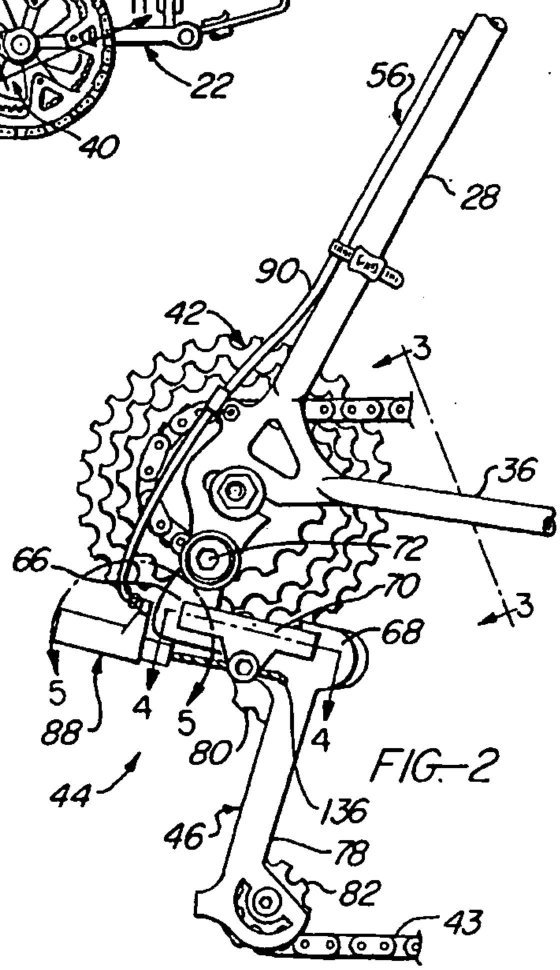


FIG.-2

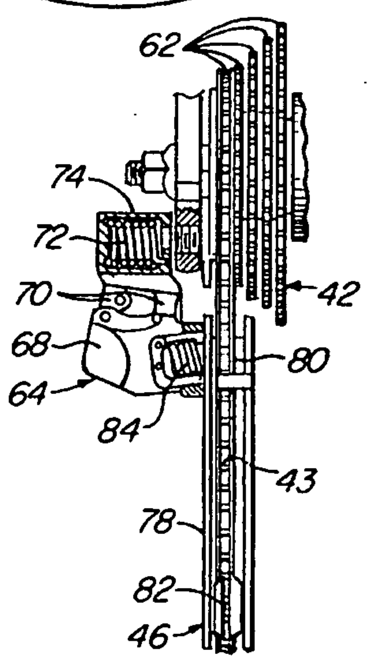


FIG.-3

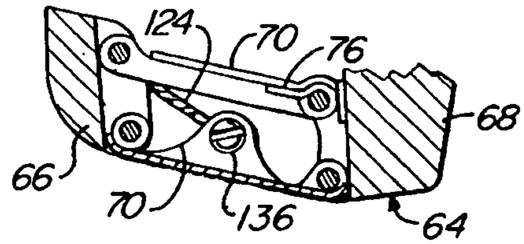


FIG.—4

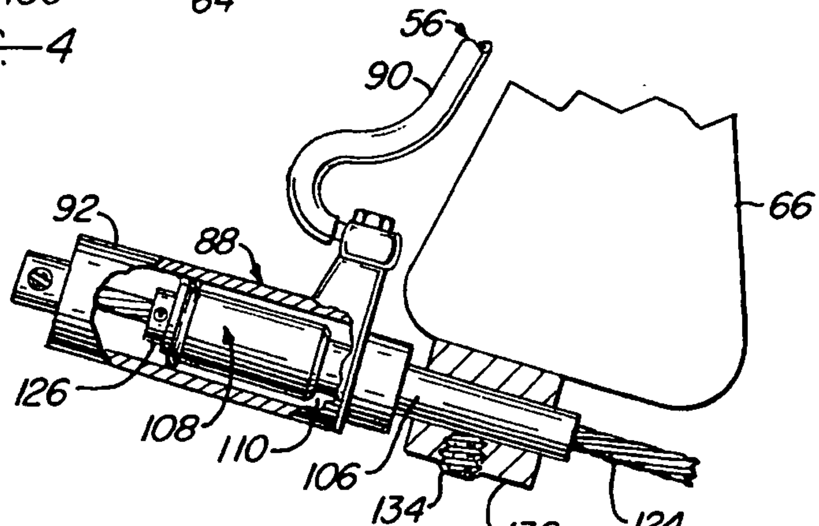


FIG.—5

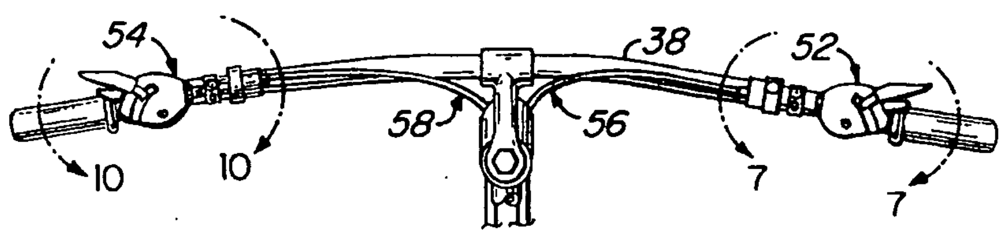


FIG.—6

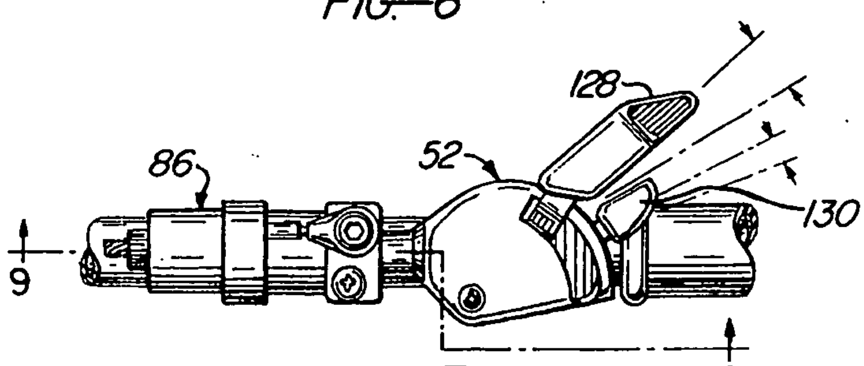
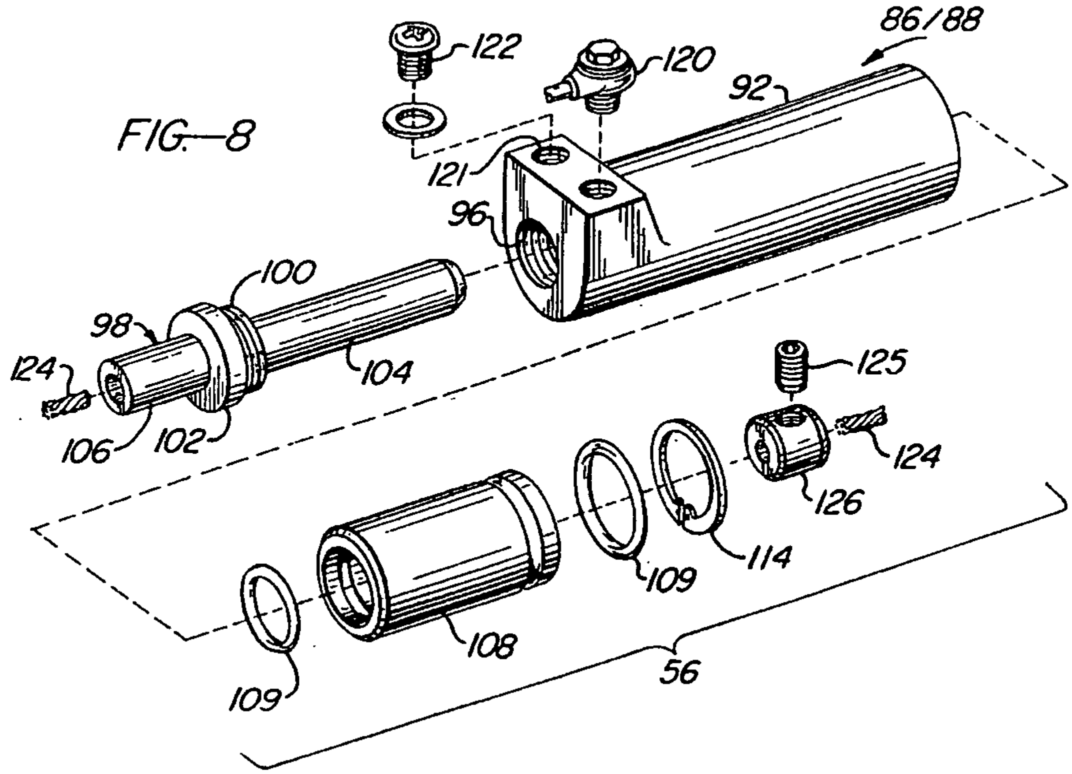


FIG.—7

FIG.—8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86/88
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121
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56

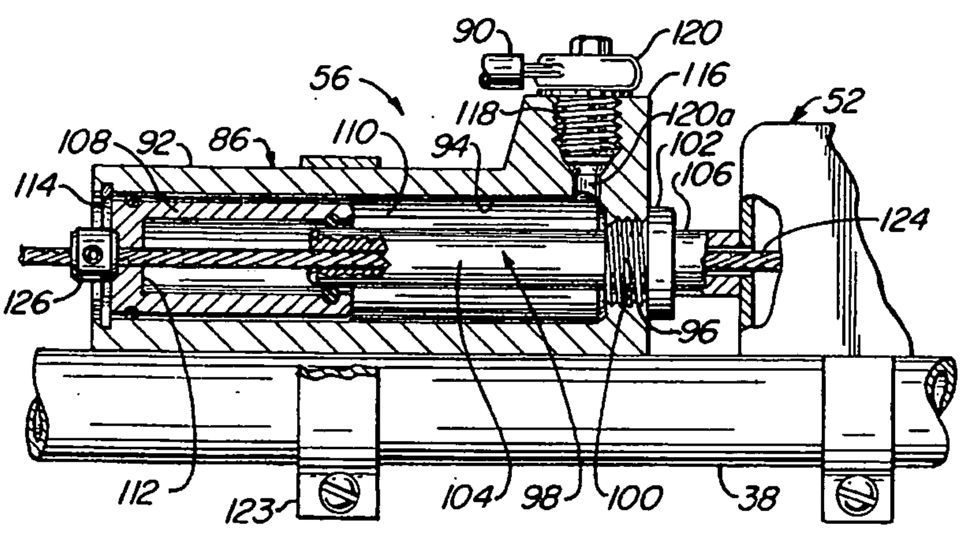

90
120
56
116
118
120a
52
108
92
86
110
94
102
106
114
124
126
96
112
123
104
98
100
38

FIG.—9

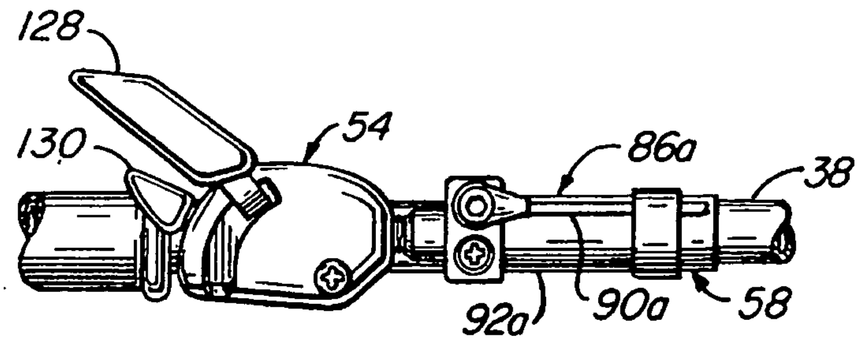

128
130
54
86a
38
92a
90a
58

FIG.—10

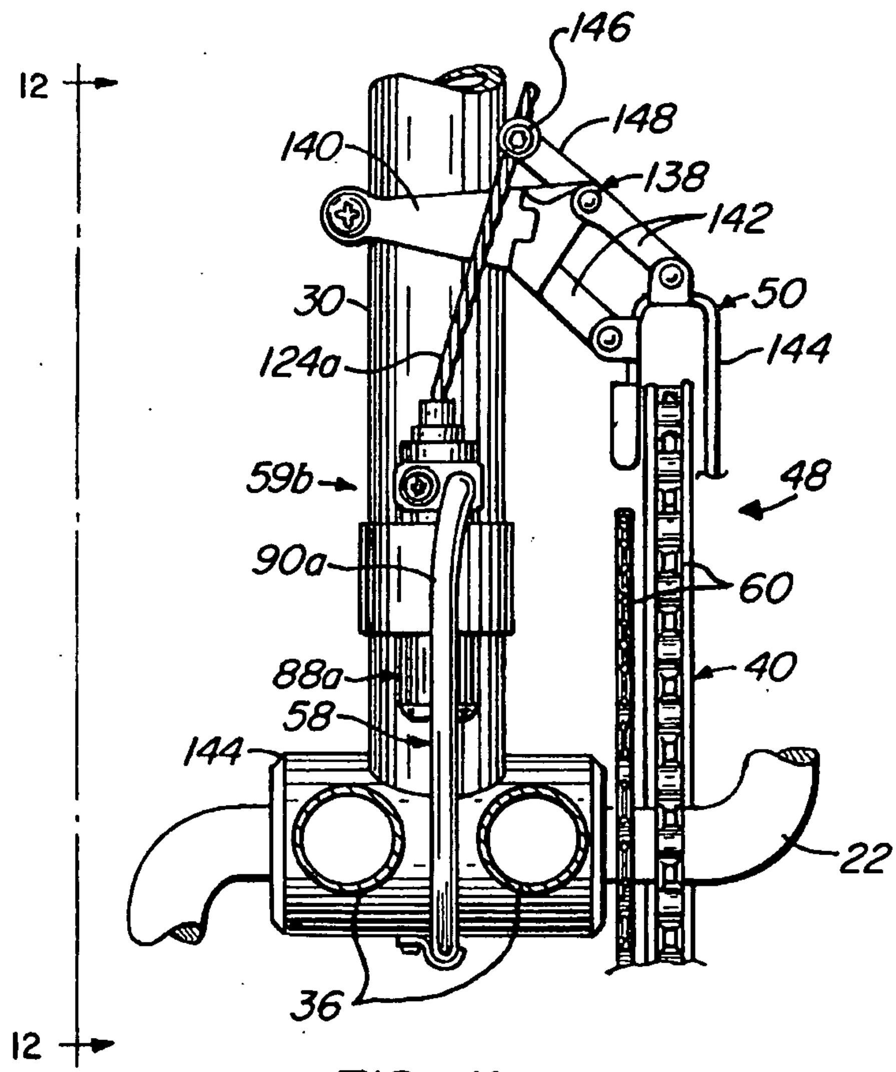
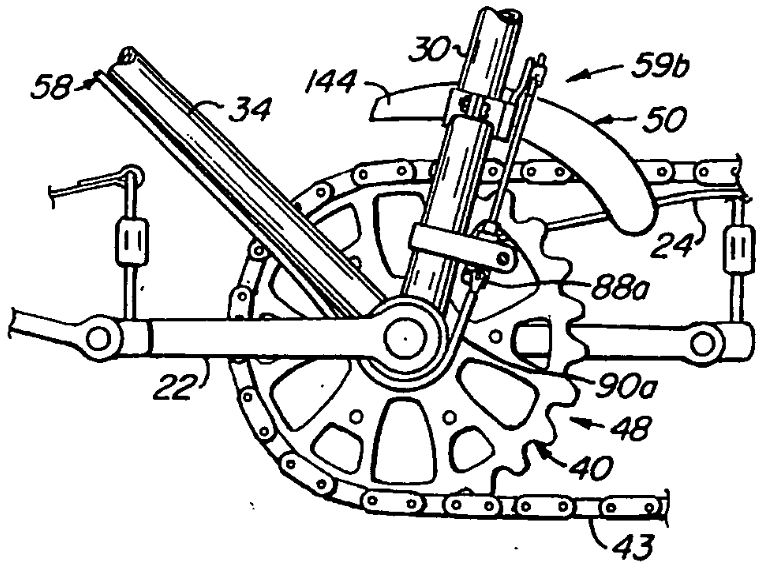

146
12
148
140
138
142
50
30
144
124a
59b
48
90a
60
40
88a
58
144
22
36
12

FIG.—11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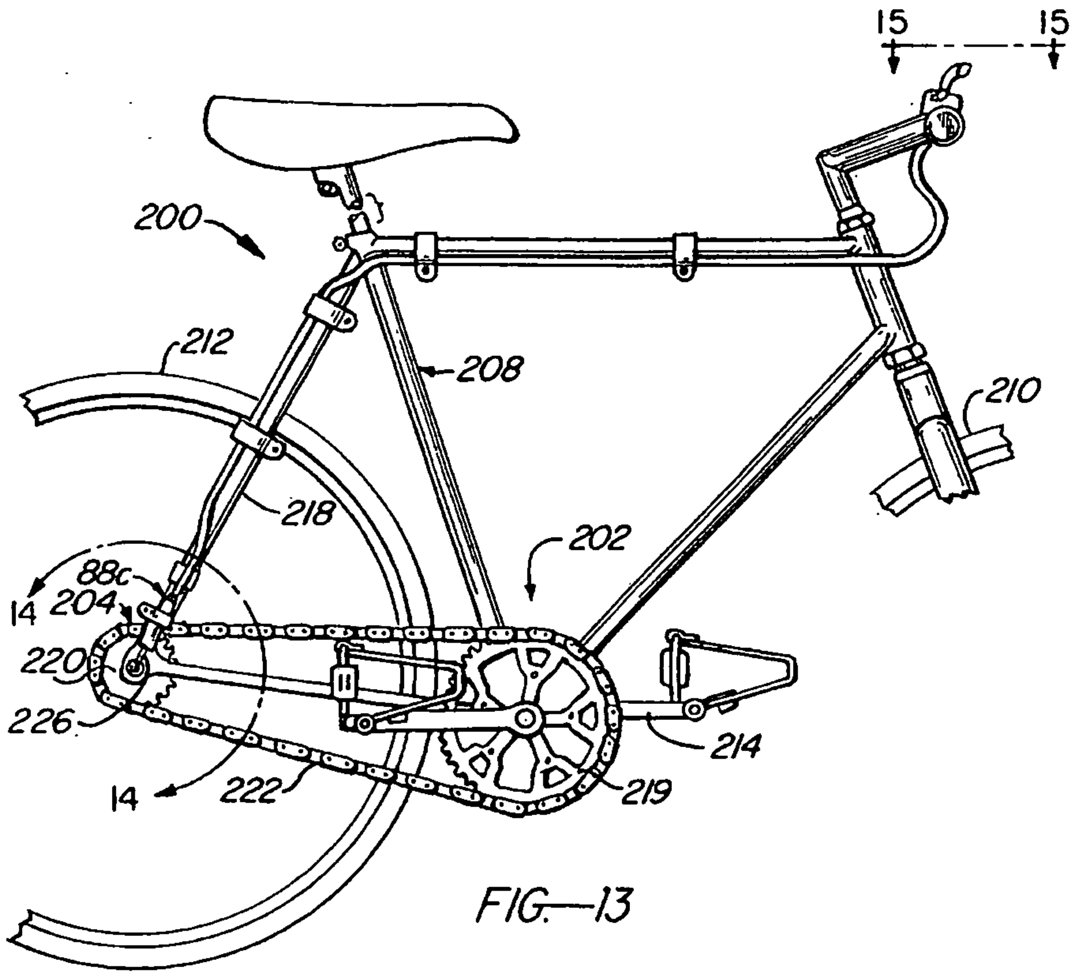
58
34
144
59b
50
24
88a
22
90a
48
40
43

FIG—12


15
15
200
212
208
210
218
202
88c
14
204
220
226
214
14
222
219

FIG—13

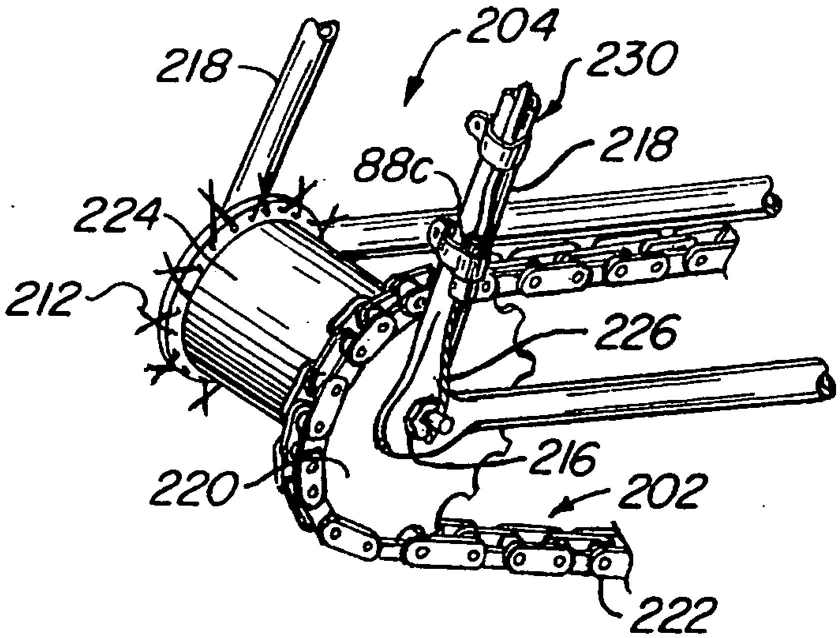

204
230
218
218
88c
224
212
226
216
220
202
222

FIG.—14

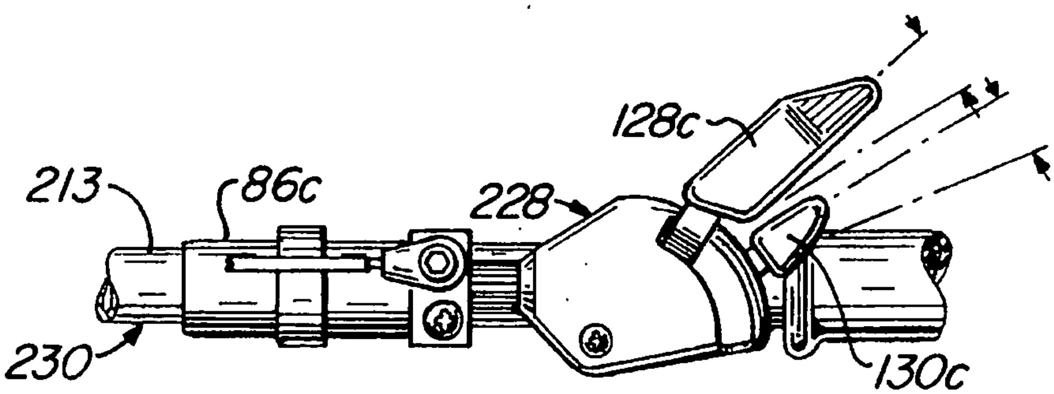

128c
213
86c
228
230
130c

FIG.—15

HYDRAULIC SHIFTING SYSTEM FOR RIDER PROPELLED VEHICLE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to shiftable variable ratio sprocket chain drives of the kind having an adjustable shifting mechanism operable by a shifting actuator for varying the drive ratio of the drive. The invention relates more particularly to an improved sprocket chain drive of this kind embodying a novel hydraulic shifting system and to a rider propelled vehicle, such as a bicycle, embodying the improved chain drive. The invention relates also to a novel hydraulic connector for such chain drives.

2. Discussion of the Prior Art

Shiftable variable ratio sprocket chain drives of the kind to which this invention relates are most commonly used on bicycles, such as racing bicycles and so-called mountain bikes. The present invention is intended primarily for use on such bicycles and will be described in this context. It will become readily evident as the description proceeds, however, that the invention may be used on other rider propelled vehicles and other devices having a shiftable variable ratio sprocket chain drive of the character described.

A conventional variable speed bicycle of the kind referred to above has a frame, a rear drive wheel and a front steerable wheel, a seat for the rider, a handle bar for steering the front wheel, a rotary crank mounting pedals to be engaged by the rider's feet for rotating the crank with pedaling action, and a shiftable variable ratio sprocket chain drive connecting the crank and the rear wheel. Rotation of the crank in one direction drives the rear wheel in a direction to propel the bicycle forwardly. The crank may or may not freewheel relative to the rear wheel in the opposite direction of crank rotation.

There are at present two different basic types of such sprocket chain drives. While these two types of drives differ in their construction and operation, they share the common features of a shifting actuator mounted on the bicycle in a position conveniently accessible to the bicycle rider and commonly on the handle bar, and a mechanical cable connecting the actuator to the shifting mechanism of the transmission in such manner that adjustment of the actuator by the rider operates the shifting mechanism to vary the drive ratio of the transmission.

The most common type of shiftable, variable ratio sprocket chain drive for bicycles embodies a so-called derailleur shifting mechanism which is operable to adjust the drive ratio of the sprocket chain drive. In this disclosure, "drive ratio" is defined as the number of revolutions of the pedal crank per revolution of the rear wheel. This type of bicycle sprocket chain drive includes front sprocket means associated with the bicycle pedal crank, rear sprocket means associated with the rear bicycle wheel, and a sprocket chain trained about and in driving engagement with the front and rear sprocket means. The front sprocket means is drivably coupled to the pedal crank for rotation of the front sprocket means by the crank. The rear sprocket means is drivably coupled to the rear bicycle wheel for rotation of the rear wheel in a forward direction (i.e. in a direction to propel the bicycle forwardly) by rotation of the rear sprocket means in a forward direction. The rear sprocket means may freewheel in the opposite direction relative to the rear wheel.

At least one sprocket means of the sprocket chain drive comprises a cluster of coaxial chain sprockets of progressively differing diameters. The several sprockets of each cluster are drivably joined for rotation in unison. Associated with each sprocket cluster is a derailleur shifting mechanism including a shifting member which is adjustable axially of the cluster to shift the adjacent portion of the sprocket chain from one cluster sprocket to the next in one axial direction of the cluster to increase the drive ratio and in the opposite axial direction of the cluster to decrease the drive ratio. The shifting member is urged on one of these directions by a derailleur spring.

The derailleur mechanism includes an idler tension sprocket or pulley about which the chain passes and which is spring biassed in a direction to take up excess slack created in the sprocket chain during shifting of the chain from a larger sprocket to a smaller sprocket. This tension sprocket yields in the opposite direction to provide chain slack during shifting of the chain from a smaller sprocket to a larger sprocket and acts to continuously maintain a proper chain tension in all positions of the derailleur shifting mechanism.

A conventional bicycle with either or both front and rear derailleur shifting mechanisms has a separate shifting actuator for operating each derailleur mechanism. Each shifting actuator is connected by a wire cable to the adjustable shifting member of the respective shifting mechanism and includes actuator means (either a single actuator member or a pair of actuator members) operable by the bicycle rider. Each actuation of a shifting actuator involves adjustment or movement of its actuating means which operates the corresponding derailleur mechanism through the corresponding wire cable to shift the adjacent portion of the sprocket chain from one sprocket to the next sprocket of the respective sprocket cluster to increase or decrease, as the case may be, the drive ratio of the sprocket chain drive. A single derailleur shifting mechanism provides a certain range of drive ratios. The two derailleur mechanisms of a bicycle having both front and rear derailleur mechanisms are selectively adjustable individually and in combination to provide a much wider range of drive ratios. Examples of bicycles having such derailleur shifting mechanisms are described in U.S. Pat. No. 4,938,324, dated Jul. 3, 1990 to Van Dyke and U.S. Pat. No. 5,102,372, dated Apr. 7, 1992 to Patterson et al. U.S. Pat. No. 3,899,057 to Carre describes a hydraulic brake system for a bicycle.

Another type of shiftable variable ratio sprocket chain drive for bicycles utilizes a rear wheel shifting mechanism commonly referred to as an internal gear shifting mechanism. This type of sprocket chain drive comprises a single sprocket rigid on the bicycle pedal crank, a single sprocket coupled to the rear bicycle wheel through the gear shifting mechanism, and a sprocket chain trained about these sprockets. The gear shifting mechanism comprises a shiftable gear train which is contained within the central hub of the rear wheel and drivably couples the rear sprocket to the rear wheel. This gear train includes an adjustable shifting member operatively connected to a shifter chain which extends externally of the hub through an axial bore in the rear wheel axle. This shifting member is adjustable in one direction to increase and in the opposite direction to decrease the gear ratio or drive ratio of the mechanism (i.e. the number of rear wheel revolutions per pedal crank revolution). Pulling the outer end of the shifter chain moves the shifting member in one of these directions against the force of a spring embodied in the shifting mechanism.

A bicycle equipped with such a gear shifting mechanism has a shifting actuator which may be similar to that used with a derailleur shifting mechanism. This shifting actuator

is mounted on the bicycle in a position easily accessible to the bicycle rider, such as on the bicycle handlebar, and is operatively connected by a wire cable to the shifter chain of the internal gear shifting mechanism. This shifting actuator is operable by the rider to pull on or release the shifter chain in increments in such manner as to step the shifting mechanism through its range of drive ratios.

The existing shiftable variable ratio bicycle sprocket chain drives of the kind discussed above have certain deficiencies which are cured by this invention. These deficiencies result from the fact that each rider-operated shifting actuator of the sprocket chain drives is connected to the adjustable shifting member of the respective shifting mechanism by a wire cable connector comprising a wire cable which extends slidably through cable guides and protective tubes or sheaths secured to the bicycle frame. Operation of the shifting actuator in one direction pulls the cable endwise in stepwise increments against the opposing force of the spring embodied in the shifting mechanism to move the adjustable shifting member of the shifting mechanism stepwise in one direction through its different drive ratio positions. Operation of the shift actuator in the opposite direction releases the cable in increments for stepwise return of the shifting member in the opposite direction through its different drive ratio positions by spring action.

These existing wire cable-actuated shifting systems for variable ratio sprocket chain drives have certain undesirable characteristics which adversely affect the shifting action of the chain drives. Among the foremost of these undesirable characteristics are the following. Dirt and grit tend to accumulate in and thereby resist free endwise sliding movement of the shift cable through the cable guides and sheaths. This resistance interferes with proper shifting action of the chain drives. Further, the wire cables of the cable connectors are quite long and tend to stretch over a period of time. This cable stretch introduces a certain sponginess into the shifting action which greatly interferes with or prevents proper shifting from one drive ratio to another. Moreover, wire cable shifting systems require frequent adjustment to compensate for such cable stretching. Even disregarding the adverse consequence of such cable stretching, the relatively long lengths of the wire cable connectors, particularly the rear wheel connector, introduces a certain play or lost motion into the shifting action which interferes with proper shifting of the chain drives from one drive ratio to another. Accordingly, there is a definite need for an improved shiftable, variable ratio sprocket chain drive of the character described.

BRIEF DESCRIPTION OF THE INVENTION

This invention provides such an improved shiftable, variable ratio sprocket chain drive. The improved drive is intended primarily for use on bicycles and will be described in this context. However, it will become evident as the description proceeds that the improved sprocket chain drive may be used on other types of rider propelled vehicles and for other purposes than driving rider propelled vehicles.

Simply stated, this invention provides an improved shiftable variable ratio sprocket chain drive comprising a shifting mechanism, and hydraulic shifting means connected to the shifting mechanism for shifting the mechanism to vary the drive ratio of the chain drive. The shifting mechanism includes an adjustable shifting member, and the hydraulic shifting means comprises a shifting actuator and a novel hydraulic connector according to the invention connecting the shifting actuator and the shifting member in a manner such that operation of the shifting actuator adjusts the shifting member hydraulically through the hydraulic connector.

The hydraulic connector comprises a pair of hydraulic units, referred to herein as an input unit and an output unit, respectively, each containing a hydraulic chamber, and an hydraulic tube or hose connecting the hydraulic chambers of the two units for hydraulic fluid flow between the chambers. The hydraulic input unit of the hydraulic connector includes an input member and the hydraulic output unit of the hydraulic connector includes an output member. Each of these members is movable in one direction to displace hydraulic fluid from a hydraulic chamber of the respective unit to a hydraulic chamber in the other unit and in the opposite direction by hydraulic fluid entering the respective chamber.

The input member of the hydraulic input unit of the present hydraulic connector is connected to the shifting actuator of the sprocket chain drive to be controlled. The output member of the hydraulic output unit is connected to the adjustable shifting mechanism of the chain drive, and more specifically to the adjustable shifting member of the shifting mechanism, in such a way that the output member and the shifting member are urged in one direction by hydraulic fluid pressure in the connector and in the opposite direction by a spring in the shifting mechanism. The hydraulic connector is connected between the user operated shifting actuator and the chain drive shifting mechanism in such manner that adjustment of the shifting actuator moves the input member of the connector input unit in one direction or the other. This movement of the input member of the hydraulic connector effects corresponding movement of the output member of the hydraulic connector and thereby of the adjustable shifting member of the shifting mechanism by the combined action of hydraulic pressure in the connector and the opposing spring force in the shifting mechanism to effect stepping of the adjustable shifting member in one direction or the other through its variable ratio positions.

This invention is primarily designed for use on a multi-speed bicycle and is described herein in connection with bicycle having derailleur shifting mechanisms and a bicycle having a gear shifting mechanism. In this use, each cable connector on the bicycle is replaced by a hydraulic connector according to this invention. To this end, the hydraulic input unit of each hydraulic connector is mounted on the bicycle adjacent an existing rider-operated shifting actuator on the bicycle. The input member of the connector hydraulic input unit is connected to the adjacent shifting actuator, preferably by a short length of metal cable. Similarly, the hydraulic output unit of each hydraulic connector is mounted on the bicycle closely adjacent the respective adjustable shifting mechanism of the sprocket chain drive. The movable output member of the connector hydraulic output unit is connected to the adjacent shifting mechanism, preferably by another short length of metal cable.

Each shifting actuator and its hydraulic connector together form an hydraulic shifting means for the shifting mechanism of the sprocket chain drive. This shifting means and the corresponding shifting mechanism of the sprocket chain drive form a hydraulic shifting system for adjusting the drive ratio of the sprocket chain drive. Because this hydraulic shifting system utilizes non-compressible hydraulic fluid rather than long stretchable wire cables to operatively connect each shifting actuator to its shifting mechanism and requires no cable guides and sheaths, the hydraulic shifting system and sprocket chain drive embodying same are not subject to the earlier stated disadvantages of the

existing wire cable connectors and sprocket chain drives embodying such cable connectors.

According to another aspect of this invention, the hydraulic input unit and the hydraulic output unit of the hydraulic connector are uniquely constructed an arranged to permit the connector to be easily retrofitted on a bicycle or other sprocket chain driven device as a replacement for the conventional cable connector(s). Moreover, as noted earlier, the invention may be utilized on other rider propelled vehicles than bicycles and, in fact, in sprocket chain drives on other than rider propelled vehicles. In this regard, it will be understood that sprocket chain drive of a bicycle or other rider propelled vehicle is essentially a rotary torque transmission in which the pedal crank is a rotary driving member. The driven wheel is a rotary driven member, and the sprocket chain transmits rotary driving torque from the driving member to the driven member for driving the driven member in rotation upon rotation of the driving member.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary side elevation of a device, in this case a rider propelled vehicle and more specifically a bicycle, having a shiftable variable ratio sprocket chain drive including an hydraulically actuated derailleur shifting system according to this invention;

FIG. 2 is an enlargement of the area encircled by the arrow 2—2 in FIG. 1;

FIG. 3 is a view looking in the direction of the arrows on line 3—3 in FIG. 2;

FIG. 4 is an enlarged section taken on line 4—4 in FIG. 2;

FIG. 5 is an enlargement, partially broken away, of the area encircled by the arrow 5—5 in FIG. 2;

FIG. 6 is an enlarged view looking in the direction of the arrows on line 6—6 in FIG. 1;

FIG. 7 is an enlargement of the area encircled by the arrow 7—7 in FIG. 6;

FIG. 8 is an exploded perspective view of one hydraulic unit of the hydraulic connector of this invention;

FIG. 9 is an enlarged section taken on line 9—9 in FIG. 7;

FIG. 10 is an enlargement of the area encircled by the arrow 10—10 in FIG. 6;

FIG. 11 is an enlarged section taken on line 11—11 in FIG. 1;

FIG. 12 is a view taken on line 12—12 in FIG. 11;

FIG. 13 is a view similar to FIG. 1 of a bicycle, having a sprocket chain drive including a Sachs shifting system according to this invention;

FIG. 14 is perspective view of the area encircled by the arrow 14—14 in FIG. 13; and

FIG. 15 is an enlarged view taken on line 15—15 in FIG. 13.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Turning now to these drawings and first to FIGS. 1–12, there is illustrated a device 10 having an improved hydraulically shiftable variable ratio sprocket chain drive 12 according to the invention. The particular device illustrated is a rider propelled vehicular device, specifically a multi-speed bicycle which constitutes the primary intended use of the invention. As noted earlier, however, and will become readily evident as the description proceeds, the invention may be used on other types of devices and especially on other types of rider propelled vehicles.

Except for the improved hydraulically shiftable sprocket chain drive 12, the vehicular device or bicycle 10 is conventional and, in this case, substantially identical to the bicycle illustrated and described in the earlier mentioned U.S. Pat. No. 5,102,372. For this reason, it is necessary to describe the bicycle only in sufficient detail to provide a clear and complete understanding of this invention. With this in mind, the bicycle 10 has a frame 14 supported on a front steering wheel 16 and rear driven wheel 18, a seat 20, and a pedal crank 22 rotatably mounted on the frame and including pedals 24 engagable by the rider's feet. The sprocket chain drive 12 drivably connects the pedal crank 22 to the rear wheel 18 in such manner that rotation of the crank in the clockwise direction in FIG. 1 by the rider drives the rear wheel in a direction to propel the bicycle forwardly. Frame 14 comprises a front frame fork 26 and a main frame portion including a head tube 27 and a rear fork 28 rigidly joined by frame members 30, 32, 34, 36. The front fork 26 straddles and rotatably supports the front wheel 16 and is journalled in the head tube 27. A handlebar 38 is fixed to the upper end of the front fork for steering the bicycle. The rear fork 28 straddles and rotatably supports the rear wheel 18.

The sprocket chain drive 12 comprises front sprocket means 40 rigidly coaxially mounted on the pedal crank 22 for rotation with the crank, rear sprocket means 42, and a sprocket chain 43 trained about and in driving engagement with the front and rear sprocket means, whereby rotation of the crank rotates the drives the rear sprocket means in rotation. The rear sprocket means 42 is connected to the rear wheel 18 by a one way drive mechanism (not shown), whereby rotation of the rear sprocket means in the clockwise direction in FIGS. 1 drives the rear wheel in a direction to propel the bicycle forwardly. The rear sprocket means freewheels relative to the rear wheel in the opposite direction of rotation. It is evident at this point that sprocket chain drive 12 is essentially a rotary torque transmission device in which the pedal crank 22 is a rotary driving member, the rear wheel 18 is a rotary driven member, and the sprocket chain 43 transmits rotary driving torque from the driving member to the driven member for driving the driven member in rotation upon rotation of the driving member.

The sprocket chain drive 12 is a shiftable variable ratio drive comprising a rear shifting mechanism 44 including adjustable shiftable means 46 and a front shifting mechanism 48 including adjustable shiftable means 50. These two shiftable means are adjustable individually and in combination to vary the drive ratio of the chain drive. In this disclosure, the drive ratio is defined as the number of revolutions of the pedal crank 22 per revolution of the rear wheel 18. Mounted on the handle bar 38 are a pair of shifting actuators 52, 54 for operating the shifting mechanisms 44, 48, respectively. These shifting actuators are connected to their respective shifting mechanism by hydraulic connectors 56, 58 according to this invention in such manner that actuation of each shifting actuator operates the corresponding shifting mechanism to vary the drive ratio of the sprocket chain drive 12. Each shifting actuator 52, 54 and its hydraulic connector 56, 58 forms a rider operated hydraulic shifting means for shifting the corresponding shifting mechanism 44, 48. These hydraulic shifting means and the corresponding shifting mechanisms together form rear and front hydraulic shifting systems 59*a*, 59*b*.

Except for the shifting actuators 52, 54 and the hydraulic connectors 56, 58, the shiftable sprocket chain drive 12

described to this point is substantially identical to that described in U.S. Pat. No. 5,197,927. The shifting actuators 52, 54 differ from those of the latter patent but are conventional bicycle shifting actuators never-the-less. The hydraulic connectors 56, 58 constitute a major improvement feature of this invention. These hydraulic connectors effect actuation of the chain drive shifting mechanisms 44, 50 in response to operation of the shifting actuators 52, 54 by hydraulic action rather than by mechanical pulling action as do conventional wire cable connectors and are not subject to the earlier mentioned disadvantages of wire cable connectors.

Referring now in more detail to FIGS. 1–12, the illustrated shiftable variable ratio sprocket chain drive 12 is derailleur shifting drive which is identical to that described in U.S. Pat. No. 5,197,927 except for the hydraulic connectors 56, 58 of this invention. Front sprocket means 40 of the drive comprises a cluster of coaxial sprockets 60, in this instance two sprockets, of different diameters rigid on and coaxial with the pedal crank 22. Rear sprocket means 42 of the drive comprises e cluster of coaxial sprockets 62, in this instance five sprockets, of progressively differing diameters. Sprockets 62 are rigidly joined to one another and coupled to the rear wheel 18 in the manner explained earlier.

Shifting mechanisms 44, 48 of the sprocket chain drive 12 comprise derailleur mechanisms. Referring to FIGS. 2–5, the rear derailleur shifting mechanism 44 comprises a parallelogram support 64 including a rear support arm 66 having normally upper and lower ends, a forward body 68, and a pair of parallel arms 70 pivotally attached at their rear ends to the lower end of the support arm and at their front ends to the body. The upper end of the support arm 66 is pivotally attached by a bolt 72 to the lower end of the rear fork arm 28 at the outer side of the rear sprocket cluster 42 for pivoting of the parallelogram support 64 on a pivot axis parallel to the axis of the rear sprocket cluster 42. The parallelogram support 64 is urged clockwise in FIG. 2 about the bolt 72 by a spring 74 (FIG. 3) about the bolt. The parallel arms 70 support the parallelogram body 68 on the parallelogram support arm 66 for movement axially of the rear sprocket cluster 42 toward and away from the rear wheel 18. A derailleur spring 76 (FIG. 4) in the parallelogram support urges the parallelogram body 68 outwardly away from the rear wheel. Pivotally mounted at one end on the parallelogram body 68 on an axis substantially parallel to the axis of the rear sprocket cluster 42 and depending below the body is a sprocket support arm or cage 78. Rotatably mounted on this cage on axes substantially parallel to the cage pivot axis are a shifting sprocket 80 directly adjacent the rear sprocket cluster 42 and a tension sprocket 82 at the lower end of the cage. The sprocket chain 43 extends about the sprocket clusters 40, 42, the shifting sprocket 80, and the tension sprocket 82 in the manner shown in FIGS. 1 and 2. The sprocket cage 78 is urged clockwise in FIG. 2 relative to the parallelogram support 64 by a spring 84 (FIG. 3).

The rear derailleur mechanism 44 as described to this point is substantially identical to that of U.S. Pat. No. 5,197,927. The parallelogram support 64 and sprocket cage 78 of the derailleur mechanism constitute the earlier mentioned adjustable shiftable means 46 of the rear derailleur mechanism. As described more fully in the patent, the rear derailleur mechanism 44 is operable in downshifting and upshifting modes. In the downshifting mode, the derailleur shiftable means 46 is adjusted outwardly away from the rear wheel 18 in stepwise fashion by the force of the derailleur spring 76 to shift the sprocket chain 43 outwardly along the rear sprocket cluster 42 stepwise from the largest sprocket to the smallest sprocket of the rear cluster. In the upshifting mode, the derailleur shiftable means 46 is adjusted inwardly toward the rear wheel in stepwise fashion against the bias of the derailleur spring 76 to shift the sprocket chain 43 inwardly along the rear sprocket cluster stepwise from the smallest sprocket to the largest sprocket of the rear cluster.

As mentioned earlier, a major improvement feature of this invention resides in the hydraulic connectors 56, 58. These connectors are essentially identical so that a description of one will suffice for both. Hydraulic connector 56 is described below using certain reference numerals. In the later discussion, these same reference numerals, with the subscript a, are used to designate the corresponding elements of hydraulic connector 58 which are visible in the drawings. Those elements of the hydraulic connector 58 which are not visible in the drawings are designated by the same reference numerals with the subscript a, both in parenthesis, as their corresponding elements in the hydraulic connector 56.

Hydraulic connector 56 connects the shifting actuator 52 to the rear derailleur mechanism 44 to operate the rear derailleur mechanism by hydraulic action in response to operation of the shifting actuator. This hydraulic connector comprises a pair of identical hydraulic units 86, 88 joined by an hydraulic tube or hose 90. Hydraulic unit 86 is referred to herein as a hydraulic input unit or simply an input unit. Hydraulic unit 88 is referred to herein as a hydraulic output unit or simply an output unit.

As shown best in FIGS. 8 and 9, each hydraulic unit 86, 88 comprises a cylinder 92 containing an axial bore 94 opening through one end of the cylinder. At the other end of the cylinder, referred to as its head end, is a threaded bore 96 coaxial with and opening to the adjacent end of the cylinder bore. Extending coaxially through the bore 94 is a tubular part 98 having a threaded portion 100 threaded in the opening 96 and an enlarged shoulder 102 seating against the outer surface of the adjacent end of the cylinder. Tubular part 98 includes a relatively long inner sleeve portion 104 extending coaxially through the bore 94 and a relatively short outer sleeve portion 106. The inner sleeve portion 104 terminates a distance from the open end of the cylinder 92 and forms with the wall of the bore 94 an annular space about the inner sleeve portion.

Extending through this annular space and slidable on the inner sleeve portion 104 is a cup-shaped piston 108 which is sealed to the sleeve portion and to the surrounding wall of the bore 94 by seal rings 109. This piston, the cylinder 92, and the sleeve portion 104 form an annular hydraulic chamber 110 whose volume is increased and reduced by axial movement of the piston. The end of the piston 108 adjacent the open end of the cylinder is closed by an end wall 112. Movement of the piston toward the open end of the cylinder is limited by a snap-ring stop 114 removably positioned within a circumferential groove in the wall of the bore 94.

Cylinder 92 has a radial boss 116 at its head end containing a threaded bore 118 opening to the head end of the cylinder bore 94 and through the outer end of the boss. Threaded in this bore is a fitting 120 to which one end of the hydraulic tube 90 is attached. This fitting contains a passage 120a forming a port in the cylinder communicating the passage in the tube to the cylinder chamber 110. The cylinder boss 116 also contains a threaded port 121 sealed by a removable plug 122 through which hydraulic fluid may be introduced into the cylinder chamber 110.

As shown best in FIG. 9, the hydraulic input unit 86 of hydraulic connector is mounted on the handlebar 38 just inboard of the shifting actuator 52 and with the head end of the actuator cylinder 92 adjacent the latter actuator. The unit may be attached to the handlebar in any convenient way, as by means of a strap clamp 123. The piston 108 in the input unit is connected to the shifting actuator 52 by a short length of metal cable 124. One end of this cable extends slidably through the tubular part 98 of the input unit 86 and through a hole in the end wall 112 of the piston. Fixed on the outer end of cable 124 by a set screw 125 is a shoulder member 126 engagable with the outer side of the piston end wall 112, whereby endwise movement of the cable to the right in FIG. 9 with the shoulder member 126 in contact with the piston end wall moves the piston 108 to the right in the cylinder 92. Endwise movement of the cable to the left accommodates movement of the piston to the left in the cylinder.

The shifting actuators 52, 54 are conventional actuators of the kind used on many bicycles having conventional derailleur shifting systems which utilize wire cable connectors to connect the actuators to the derailleur shifting mechanisms. Accordingly, it is unnecessary to describe these actuators in elaborate detail. Suffice it to say that each shifting actuator 52, 54 includes a pair of shift levers 128, 130 operable by the rider and an internal cable feed mechanism (not shown) operated by the levers. In a conventional derailleur shifting system, one end of the wire cable of a conventional cable connector is connected to this internal feed mechanism of a shifting actuator. This internal feed mechanism operates to pull the cable into the actuator in increments against the force of the derailleur spring (i.e. spring 76 in FIG. 4) in response to operation of the actuator in a first mode involving alternate depression and release of the actuator shift lever 128 in the manner indicated by the arrows in FIG. 7. Operation of the actuator in a second mode involving alternate depression and release of the actuator shift lever 130 in the manner indicated by the arrows in FIG. 7 releases the cable intermittently for endwise movement of the cable from the actuator in increments by the force of the derailleur spring.

In the present invention, the outer end of the cable 124 of the hydraulic input unit 86 of hydraulic connector 56 extends into the shifting actuator 52, as shown in FIG. 9. The cable 124 is connected to the internal cable feed mechanism in the shifting actuator 52 in the same manner as the wire cable of a conventional wire cable connector, whereby cable 124 is pulled stepwise to the right in FIG. 9 into the actuator and pulls the piston 108 stepwise toward the head end of its cylinder 92 in response to alternate depression and release of the shift lever 128 of the shifting actuator. Alternate depression and release of the shift lever 130 of the shifting actuator 52 releases the cable 124 intermittently for left hand stepwise movement of the cable and piston 108 in FIG. 9.

At this point it should be noted that the cable 124 connecting the hydraulic input unit 86 to the shifting actuator 52 may be provided in either of two ways. For example, the cable 124 may be provided by simply cutting to an appropriate length the end of an existing conventional wire connector cable connected to the shifting actuator. This method may be used to advantage, for example, when retrofitting this invention on a bicycle having a derailleur shifting system connected to a shifting actuator by a conventional wire cable connector. Another way of providing the cable 124 is to provide the hydraulic input unit 86 with a cable of appropriate length for attachment to a shifting actuator which has no cable or from which an existing wire connector cable has been removed.

As shown best in FIGS. 2 and 5, the cylinder 92 of the hydraulic output unit 88 of hydraulic connector 56 is mounted on the lower end of the parallelogram support arm 66 of the rear derailleur mechanism 44. To this end, the outer sleeve portion 106 of the output unit is slidably positioned within a rigid bushing 132 on the lower end of the parallelogram support arm 66. In the conventional rear derailleur mechanism of U.S. Pat. No. 5,197,927, this bushing receives the lower end of the conventional cable connector. The sleeve portion 106 of the hydraulic output unit 88 is releasably fixed in the bushing 132 by a set screw 134. As shown best in FIG. 2 and 4, the outer end of the cable 124 of the hydraulic output unit 88 is secured to a cable clamp 136 on the outer arm 70 of the rear derailleur parallelogram support 64. The cable extends rearwardly and inwardly from the cable clamp at an acute angle relative to the outer parallelogram arm, as shown in FIG. 4, whereby a left hand endwise force on the cable in FIGS. 2, 4, and 5 tends to pull the parallelogram support 64 and the derailleur sprocket cage 78 inwardly toward the rear wheel 18, axially of the rear sprocket cluster 42 against the outward bias force of the rear derailleur spring 76. The hydraulic shifting structure described above constitutes the hydraulic shifting system 59*a*.

Turning now to FIGS. 1 and 10–12, it will be recalled that the shifting system 59*b* comprises a front sprocket cluster 40 rigid on the pedal crank 22, a front shifting mechanism 48 including adjustable shifting means 50, and a hydraulic connector 58 connecting the shifting mechanism 48 to the shifting actuator 54. The front sprocket cluster 40 comprises two sprockets 60 of different diameters rigidly and coaxially mounted on the pedal crank at the same side of the bicycle frame as the rear sprocket cluster 42. The shifting mechanism 48 of the hydraulic shifting system 59*b* is a derailleur mechanism comprising a parallelogram support 138 including a mounting member 140 rigidly secured to the bicycle frame member 30 a distance above the supporting hub 141 for the crank pedal 22. Pivotally secured at one end to the mounting member 140 are a pair of parallelogram arms 142 which extend toward the front sprocket cluster 40. The outer ends of the arms 142 are pivotally secured to a derailleur cage 144 which straddles the upper run of the sprocket chain 43 close to the front sprocket cluster. The parallelogram support 138 supports the derailleur cage 144 for movement generally axially of the front sprocket cluster 40 to shift the sprocket chain 43 from one sprocket 60 of the front cluster to the other. The parallelogram support 138 includes a derailleur spring (not shown) about one parallel arm pivot, like the derailleur spring 76 in FIG. 4, which urges the derailleur cage 144 inwardly toward the bicycle frame. The parallelogram arms 142 and the cage 144 together constitute the derailleur shifting means 50.

The hydraulic connector 58 connects the shifting actuator 54 to the shifting means 50 of the front derailleur mechanism 48. To this end, the hydraulic input unit 86*a* of the connector 58 is mounted on the bicycle handlebar immediately inboard of the shifting actuator 54 with the head end of its cylinder 92*a* adjacent the shifting actuator, as shown in FIG. 10. The cable (124*a*)of the input unit 86*a* is connected to the shifting actuator 54 in the same manner as the cable 124 of the input unit 86 of the hydraulic connector 56 is connected to the shifting actuator 52 in FIG. 9. The output unit 88*a* of the hydraulic connector 58 is firmly mounted on the bicycle frame member 30 in the manner illustrated in FIGS. 11 and 12. The cable 124*a* of the output unit 88*a* is attached to a cable clamp 146 on the outer end of an extended portion 148 of one arm 142 of the parallelogram support 138, whereby

the derailleur spring in this support urges the latter cable, and thereby also the piston within the hydraulic output unit 88a upwardly in FIG. 10, relative to the cylinder 92 of the output unit.

The improved shiftable variable ratio sprocket drive 12 of the invention operates in the following manner. Each hydraulic connector 56, 58 is filled with a volume of hydraulic fluid substantially equal to the displacement volume of one hydraulic unit (86 or 88, 86s or 88a) of the respective connector plus the volume of the passage in the connector hydraulic hose or tube 90, 90a of the respective connector. This displacement volume of each hydraulic unit equals the change in the volume of its hydraulic chamber 110,110a during movement of its piston 108, 108a from one end of its stroke to the other. As noted earlier, the hydraulic connectors have ports 121 for introducing hydraulic fluid into the hydraulic connectors and removable plugs 122 for sealing these ports.

The sprocket chain drive 12 has a normal state in which the sprocket chain 43 engages one sprocket 60 of the front sprocket cluster 40 and one sprocket 62 of the rear sprocket cluster 42 to drivably connect the pedal crank 22 to the rear sprocket cluster 42. In the following description, it is assumed that the sprocket chain 43 initially engages the larger sprocket 60 of the front sprocket cluster 40 and the smallest sprocket 62 of the rear sprocket cluster 42, as shown in the drawings. This illustrated position of the sprocket chain and the illustrated corresponding positions of the other elements of the sprocket chain drive are referred to as their initial positions. Rotation of the crank 22 in a clockwise direction in FIG. 1 now drives the rear wheel 18 in a clockwise direction to propel bicycle forwardly with a drive ratio equal to the ratio of the diameters of the engaged sprockets.

The rear derailleur spring 76 continuously urges the rear derailleur parallelogram support 76 and sprocket cage 78 outwardly away from the rear wheel 18 and thereby exerts a tension force on the cable 124 of the hydraulic output unit 88 of the hydraulic connector 56. This tension force urges the piston 108 of the output unit 88 toward the head end of its cylinder 92 (i.e. to the right in FIG. 5) to displace hydraulic fluid from the hydraulic chamber 110 in the unit through the tube 90 of the hydraulic connector 56 into the hydraulic chamber 110 of the input unit 86 of the connector. The hydraulic fluid urges the piston 108 of the hydraulic input unit to the left in FIG. 9 away from the shifting actuator 52 and against the shoulder 126 on the actuator cable 124. A tension force is thereby exerted on the cable which urges the cable to the left in FIG. 9 away from the shifting actuator 52 and to the position shown wherein the piston 108 in the hydraulic input unit 86 is adjacent or engages its snap ring stop 114.

Until the shift levers 128, 130 of the shifting actuator 52 are actuated (i.e. alternately depressed and released in the manner explained earlier), the cable feed mechanism within this shifting actuator firmly secures the cable 124 and hence the piston 108 of the hydraulic input unit 86 of the hydraulic connector 56 against leftward movement in FIG. 9 by the pressure of the hydraulic fluid displaced from the hydraulic output unit 88 of the connector. In the position of FIG. 9, of course, leftward movement of the piston and cable is also limited by the snap ring stop 114. Under these conditions, the hydraulic fluid within the hydraulic connector 56 hydraulically blocks right hand movement in FIG. 5 of the piston 108 in the output unit 88 of hydraulic connector 56 which right hand movement of the piston may also be blocked by engagement of the piston with the head end of its cylinder 92. The rear derailleur parallelogram support 64 and sprocket cage 78 are thereby restrained against outward movement beyond their positions of FIG. 3 by the force of the rear derailleur spring 76.

The volume of hydraulic fluid within the hydraulic connector 56 and the position of the stop shoulder 126 along the cable 124 of its hydraulic output unit 88 are made such that when the piston 108 of the hydraulic input unit 86 occupies its position of FIG. 9, the stop shoulder 126 positions the piston 108 of the hydraulic output unit 88 at or near the right end of its stroke in FIG. 5. The hydraulic fluid within the hydraulic connector 56 is then pressurized by the rightward force exerted on the output unit piston 108 by the rear derailleur spring 76. The output unit piston is thereby acted on by two opposing forces which are the internal hydraulic fluid pressure force and the external force of the rear derailleur spring 76. These opposing forces retain the rear derailleur sprocket chain cage 78 in its initial position of FIG. 3. The rear derailleur mechanism 44 may also include positive stop means for limiting outward movement of the sprocket cage 78 to its position of FIG. 3. In this position, the sprocket chain 43 engages the smallest sprocket 62 of the rear sprocket cluster 42.

Similarly, the front deraileur spring continuously urges the front derailleur parallelogram support 138 and sprocket chain cage 144 inwardly toward the bicycle frame and thereby exerts a tension force on the cable 124a of the hydraulic output unit 88a of the hydraulic connector 58. This tension force urges the piston (108a) of the output unit 88a in a direction (i.e. upwardly in FIG. 10) to displace hydraulic fluid from the hydraulic chamber (110a) in the unit through the tube 90a of the hydraulic connector 58 into the hydraulic chamber (110a) in the input hydraulic unit 86a of the hydraulic connector 58. This hydraulic fluid urges the piston (108a) in the hydraulic input unit 86a to the right in FIG. 10 away from the shifting actuator 54 and against the shoulder (126a) on its cable (124a). Until the shift levers 128, 130 of the shifting actuator 54a are actuated, the cable feed mechanism within this shifting actuator secures the cable (124a) of the hydraulic input unit 86a and hence its piston (108a) against rightward movement in FIG. 10 by the hydraulic fluid pressure in the hydraulic connector 58.

The volume of hydraulic fluid within the hydraulic connector 58 and the position of the stop shoulder (126a) along the cable 124a of the hydraulic output unit 88a are made such that when the piston (108a) of the hydraulic input unit 86a occupies a position corresponding to that of piston 108 in FIG. 9, the stop shoulder (126a) positions the piston (108a) of the hydraulic output unit 88a at or near the upper end of its stroke in FIGS. 11 and 12. The hydraulic fluid within the hydraulic connector 58 is then pressurized by the force exerted on the output unit piston (108a) by the front derailleur spring, whereby the latter piston (108a) is subjected to two opposing forces, namely internal hydraulic fluid pressure and the external front derailleur spring force. These opposing forces retain the piston of the hydraulic output unit 88a at or near the upper end of its stroke in FIGS. 11 and 12 and retain the front derailleur sprocket chain cage 144 in its position of FIG. 11. In these positions, the front sprocket chain cage 144 engages the sprocket chain 43 with the larger sprocket 60 of the front sprocket cluster 40.

The rear and front derailleur shifting mechanisms 44, 48 are operated or shifted to shift the sprocket chain 43 along the rear and front sprocket clusters 42, 40 from one sprocket to the next and thereby adjust the drive ratio of the sprocket chain drive 12 by selectively actuating, that is alternately depressing and releasing, the shift levers 128, 130 of the

shifting actuators 52, 54. Assuming the sprocket chain 43 occupies its initial position shown in the drawings, wherein the chain engages the larger sprocket 60 of the front sprocket cluster 40 and the smallest sprocket 62 of the rear sprocket cluster 42, the chain is shifted to a larger sprocket of the rear sprocket cluster by depressing and releasing the actuating lever 128 of the shifting actuator 54. The chain is shifted to the smaller sprocket 60 of the front sprocket cluster by depressing and releasing the actuating lever 128 of the shifting actuator 54. The sprocket chain is shifted in the opposite directions along the sprocket clusters by depressing and releasing the shift levers 130 of the shifting actuators.

Thus, each depression and release of the shift lever 128 of the shifting actuator 52 operates its internal cable feed mechanism to pull the cable 124 and thereby the piston 108 of the hydraulic input unit 86 of the hydraulic connector 56 to the right in FIG. 9 in increments against the hydraulic fluid pressure created in the hydraulic connector by the rear derailleur spring 76. This incremental movement of the piston to the right in FIG. 9 displaces hydraulic fluid in increments from its hydraulic chamber 110 through the respective hydraulic tube 90 into the hydraulic chamber 110 of the hydraulic output unit 88 of the hydraulic connector 56. The hydraulic fluid entering the latter chamber forces its piston 108 to the left in increments in FIG. 5 and thereby pulls the rear derailleur sprocket cage 78 inwardly in increments along the rear sprocket cluster 42 against the force of the rear derailleur spring 76. This shifts the sprocket chain 43 inwardly from one sprocket 62 of the rear sprocket cluster 42 to the next large sprocket and thereby varies the sprocket chain drive ratio.

Each depression and release of the shift lever 130 of the shifting actuator 52 acts to release the cable 124 and thereby the piston 108 of the hydraulic input unit 86 of the hydraulic connector 56 for incremental movement to the left in FIG. 9 by the hydraulic fluid pressure created in the hydraulic connector 56 by the rear derailleur spring 76. This incremental movement of the piston 108 to the left in FIG. 9 permits additional hydraulic fluid flow into its chamber 110 in increments from the chamber 110 of the hydraulic output unit 88 in FIG. 5. The piston 108 in the output unit 88 is thereby released for incremental movement to the right in FIG. 5, whereby the rear derailleur spring 76 moves the rear derailleur sprocket cage 78 inwardly an incremental distance along the rear sprocket cluster 42 to shift the sprocket chain 43 from one sprocket 62 to the next larger sprocket of the cluster.

At this point, it is important to note that the internal cable feed mechanism of the conventional shifting actuator 52 is so constructed and arranged that each full depression and release of the actuating lever 128 of the actuator pulls or advances the cable 124 of the hydraulic input unit 86 a certain fixed distance to the right in FIG. 9. This distance equals the distance the shifting actuator would advance a conventional wire cable connector of the kind referred to earlier. It is evident from the description to this point that each such advance of the cable effects, by hydraulic action, an equal movement of the cable 124 of the hydraulic output unit 88 to the left in FIG. 5. Similarly, each full depression and release of the actuating lever 130 of the conventional shifting actuator 52 releases the cable 124 of the hydraulic input unit 86 and hence also its piston 108 for movement the same fixed distance to the left in FIG. 9 by the hydraulic fluid pressure produced in the hydraulic connector 56 by the rear derailleur spring 76. This latter distance equals the distance a conventional wire cable would move when connected to and intermittently released by the shifting actuator.

It is evident, therefore, that each such intermittent release of the cable 124 of the hydraulic input unit 86 effects intermittent release by hydraulic action of the cable 124 of the hydraulic output unit 88 of hydraulic connector 56 for movement of the latter cable through the same distance to the right in FIG. 5. Accordingly, the present rear derailleur shifting system 59*a* is operative to shift the sprocket chain 43 inwardly and outwardly and from one sprocket 62 to the next along the rear sprocket cluster 42 in the manner described.

Similarly, actuation of the shift levers 128, 130 of the shifting actuator 54 hydraulically operates the front derailleur shifting system 59*b* to shift the sprocket chain 43 back and forth between the two sprockets 60 of the front sprocket cluster 40 in essentially the same way as described above in connection with the shifting actuator 52. It will be understood, of course, that the rear derailleur shifting actuator 52 may be operated to shift the sprocket chain 43 a number of times in succession in the same direction, for example to engage the sprocket chain with the several rear sprockets 62 in succession. In contrast, the shifting actuator 54 is operated to shift the sprocket chain back and forth between the two front sprockets in alternate sequence.

Turning now to FIGS. 13–15, there is illustrated a bicycle 200 having a shiftable variable ratio sprocket chain drive 202 including a gear shifting mechanism 204 and an hydraulic shifting system 206 according to this invention for operating the shifting mechanism. Again, except for the hydraulic shifting system 206 embodied in the sprocket chain drive 202, the bicycle 200 is conventional and hence need be described only in sufficient detail to provide a clear and complete understanding of this invention. With this in mind, the bicycle includes a frame 208 mounting front and rear wheels 210, 212, a handlebar 213, and a rotary pedal crank 214. The rear wheel 212 is mounted on an axle 216 supported at its end on the rear fork 218 of the bicycle frame 208. The sprocket chain drive 202 comprises a front sprocket 219 rigid on the pedal crank 214, a rear sprocket 220 mounted on the axle 214 and drivably coupled to the rear wheel 212 by the gear shifting mechanism 204, and a sprocket chain 222 trained about and engaging the front and rear sprockets. Clockwise rotation of the pedal crank 214 in the drawings drives the rear wheel in clockwise rotation through the gear shifting mechanism 204 to propel the bicycle forwardly.

The shifting mechanism 204 comprises a gear mechanism (not shown) within the hub 224 of the rear wheel 212 and embodies an adjustable shifting means including a shifter chain 226 extending externally of the wheel hub through an axial bore in the rear wheel axle 216, as shown best in FIG. 14. This shifter chain is pullable outwardly through the axle against the force of a spring within the hub to change the drive ratio of the mechanism in one direction. The shifter chain is returnable inwardly through the axle by spring action to change the drive ratio in the opposite direction. Mounted on the bicycle handlebar 213 is a shifting actuator 228 connected to the shifter chain 226 by a hydraulic connector 230 according to this invention.

The shifting actuator 228 is identical to the shifting actuators 52, 54 described earlier. The hydraulic connector 230 is identical to the hydraulic connectors 56, 58 described earlier. Accordingly, it is unnecessary to redescribe the shifting actuator 228 and the hydraulic connector 230. Also, those parts of the actuator and connector which are referred to below are designated by the same reference numerals, with the subscript "c", as the corresponding parts of the shifting actuators 52, 54 and hydraulic connectors 56, 58.

The reference numerals relating to those actuator and connector parts which are not visible in FIGS. 13–15 are enclosed in parenthesis.

The hydraulic input unit **86c** of the hydraulic connector **230** is mounted on the handlebar **213** close to the shifting actuator **228**. The input piston (**108c**) of the input unit **86c** is connected to the actuator in the exactly the same manner as the input piston **108** is connected to the shifting actuator **52** in FIG. 9. The hydraulic output unit **88c** of the hydraulic connector **230** is mounted on the rear frame fork **218** just above the end of the rear wheel axle **216** from which the Sachs shifter chain **226** extends. The output piston (**108c**) in the output unit **88c** is connected to the outer end of the shifter chain, as shown in FIG. 14.

The operation of the shifting variable ratio sprocket chain drive **202** is obvious from the foregoing description. Thus, operation of the shift lever **128c** of the shifting actuator **228** moves the input piston (**108c**) of the hydraulic connector **230** in a direction (i.e. to the right in FIG. 15) to displace hydraulic fluid from the hydraulic input unit **86c** of the hydraulic connector **230** to the hydraulic output unit **88c** of the connector. The hydraulic fluid entering the output unit **88c** moves its output piston (**108c**) in a direction (i.e. upwardly in FIG. 13 and rightward in FIG. 14) to pull the Sachs shifter chain **226** outwardly and thereby change the drive ratio of the gear shifting mechanism **204** in one direction. Operation of the shift lever **130c** of the shifting actuator **228** releases the input piston (**108c**) of the hydraulic connector **230** for movement in the opposite direction (i.e. to the left in FIG. 15) by the pressure of the hydraulic fluid created by the inward spring force on the shifter chain **226**. This spring force then pulls the output piston (**108c**) of the output unit **88c** of the hydraulic connector **20** in a direction (i.e. downwardly in FIG. 13 and leftward in FIG. 14) and pulls the shifter chain **226** inwardly through the rear wheel axle **216** to change the drive ratio of the gear shifting mechanism **204** in the opposite direction.

The inventor claims:

1. A rider propelled vehicle comprising:

a vehicular device comprising a frame, wheels including a driven wheel rotatably mounted on said frame, a crank rotatably mounted on said frame and adapted to be driven in rotation by a rider, shiftable variable ratio sprocket chain drive means drivably connecting said crank and said driven wheel in a manner such that rotation of said crank in one direction drives said driven wheel in rotation with a drive ratio equal to the number of revolutions of said crank per revolution of said driven wheel and in a direction to propel the vehicle forwardly, and an hydraulic shifting system operable by the rider for hydraulically shifting said drive means to change said drive ratio, and wherein

said hydraulic shifting system comprises a shifting actuator mounted on said vehicular device for operation by the rider in drive-ratio-increasing and drive-ratio-reducing modes, a drive ratio adjusting mechanism adjustable in a first adjustment direction to increase said drive ratio and in a second adjustment direction to reduce said drive ratio, a spring connected to said mechanism for urging said mechanism in one adjustment direction, a hydraulic connector extending between said actuator and said mechanism, and connecting means connecting said hydraulic connector to said actuator and said mechanism for effecting hydraulic adjustment of said mechanism in its first adjustment direction to increase said drive ratio in response to operation of said actuator in its drive-ratio-increasing mode and hydraulic adjustment of said mechanism in its second adjustment direction to reduce said drive ratio in response to operation of said actuator in its drive-ratio-reducing mode,

said hydraulic connector comprises (a) an hydraulic input unit including an input cylinder containing an axial bore closed at one end by a cylinder end wall, a tubular sleeve extending coaxially through said bore from said end wall and radially spaced from the wall of said bore to form an annular input chamber between said bore wall and said sleeve, a fluid port opening to said chamber, and a cup-shaped input piston slidable in said bore and on said sleeve and movable axially through said input chamber in a first direction to displace hydraulic fluid from said chamber through said port and movable in a second direction by fluid pressure in said chamber, (b) an hydraulic output unit including an output cylinder containing an axial bore closed at one end by an output cylinder end wall, a tubular output cylinder sleeve extending coaxially through said output cylinder bore from said output cylinder end wall and radially spaced from the wall of said output cylinder bore to form an annular output chamber between said output cylinder bore wall and said output cylinder sleeve, a fluid port opening to said output chamber, and a cup-shaped output piston slidable in said output cylinder bore and on said output cylinder sleeve and movable axially through said output chamber in a first direction to displace hydraulic fluid from said output chamber through said output chamber port and in a second direction by fluid pressure in said output chamber, and (c) a hydraulic tube connecting said ports for conducting hydraulic fluid between said chambers, and

said connecting means comprises a first cable extending slidably through said input cylinder sleeve and connecting said input piston and said actuator and a second cable extending slidably through said output cylinder sleeve and connecting said output piston and said drive ratio adjusting mechanism in a manner such that (a) operation of said actuator in one mode moves said input piston in its first direction to displace hydraulic fluid from said input chamber to said output chamber, whereby the hydraulic fluid entering said output chamber moves said output piston in its second direction and thereby moves said drive ratio adjusting mechanism in its other adjustment direction against the force of said spring to change said drive ratio in one direction, and (b) operation of said actuator in its other mode effects movement of input piston in its second direction, movement of said output piston in its first direction, and adjustment of said mechanism in its said one adjustment direction by the force of said spring to change said drive ratio in the other direction and displace hydraulic fluid from said output chamber to said input chamber.

2. A rider propelled vehicle comprising:

a vehicular device comprising a frame, wheels including a driven wheel rotatably mounted on said frame, a crank rotatably mounted on said frame and adapted to be driven in rotation by a rider, shiftable variable ratio sprocket chain drive means drivably connecting said crank and said driven wheel in a manner such that rotation of said crank in one direction drives said driven wheel in rotation with a drive ratio equal to the number of revolutions of said crank per revolution of said driven wheel and in a direction to propel the vehicle forwardly, and an hydraulic shifting system operable by

the rider for hydraulically shifting said drive means to change said drive ratio, and wherein

said hydraulic shifting system comprises a shifting actuator mounted on said vehicular device for operation by the rider in drive-ratio-increasing and drive-ratio-reducing modes, a drive ratio adjusting mechanism adjustable in a first adjustment direction to increase said drive ratio and in a second adjustment direction to reduce said drive ratio, and drive ratio adjusting means connected to said mechanism including a hydraulic connector extending between said actuator and said mechanism and connecting means connecting said hydraulic connector to said actuator and said mechanism for effecting hydraulic adjustment of said mechanism in its first adjustment direction through said hydraulic connector to increase said drive ratio in response to operation of said actuator in its drive-ratio-increasing mode and hydraulic adjustment of said mechanism in its second adjustment direction through said hydraulic connector to reduce said drive ratio in response to operation of said actuator in its drive-ratio-reducing mode, and

said connecting means includes means for effecting connection of said hydraulic connector to said actuator and said drive ratio adjusting mechanism at any time including after mounting of said actuator and said mechanism on said vehicular device.

3. A rider propelled vehicle according to claim 2 wherein:

said hydraulic connector is adapted to contain hydraulic fluid and includes movable input and output members which are hydraulically coupled by hydraulic fluid in the connector for movement of said output member in response to movement of said input member,

said connecting means comprise an input connection joining said input member and said actuator for effecting movement of said input member in response to operation of said actuator by the rider and an output connection joining said output member and said drive ratio adjusting mechanism for effecting adjustment of said mechanism in response to movement of said output member, and

said means for effecting connection of said hydraulic connector to said actuator and said drive ratio adjusting mechanism at any time including after mounting of said actuator and said mechanism on said vehicular device comprise means for selectively releasing and securing said input and output connections.

4. A rider propelled vehicle according to claim 2 wherein:

said drive ratio adjusting means includes a spring which urges said drive ratio adjusting mechanism in one adjustment direction, and

said hydraulic connector hydraulically urges said mechanism in its other adjustment direction against the force of said spring in response to operation of said actuator in one mode, and said hydraulic connector effects adjustment of said mechanism in its other adjustment direction by the force of said spring in response to operation of said actuator in its other mode.

5. A rider propelled vehicle according to claim 2 wherein:

said hydraulic connector comprises (a) an hydraulic input unit including an hydraulic input chamber, a fluid port opening to said chamber, and a movable input member movable in a first direction to displace hydraulic fluid from said chamber through said port and movable in a second direction by fluid pressure in said chamber, (b) an hydraulic output unit including an hydraulic output chamber, a fluid port opening to said output chamber, and a movable output member movable in a first direction to displace hydraulic fluid from said output chamber through said output chamber port and in a second direction by fluid pressure in said output chamber, and (c) a hydraulic tube connecting said ports for conducting hydraulic fluid between said chambers,

said connecting means comprise an input connection joining said input member and said actuator and an output connection joining said output member and said drive ratio adjusting mechanism in a manner such that operation of said actuator in one mode moves said input member in its first direction through said input connection to displace hydraulic fluid from said input chamber to said output chamber, whereby the hydraulic fluid entering said output chamber moves said output member in its second direction and thereby moves said mechanism in one adjustment direction through said output connection to change said drive ratio in one direction,

said drive ratio adjusting means includes means whereby operation of said shifting actuator in its other mode effects movement of said output member in its second direction and thereby adjustment of said drive ratio adjusting mechanism in its other adjustment direction to change said drive ratio in the other direction and displace hydraulic fluid from said output chamber to said input chamber, and

said means for effecting connection of said hydraulic connector to said actuator and said drive ratio adjusting mechanism at any time including after mounting of said actuator and said mechanism on said vehicular device comprise means for selectively releasing and securing said input and output connections.

6. A rider propelled vehicle according to claim 5 wherein:

said input member comprises an input piston movable in said input chamber,

said output member comprises an output piston movable in said output chamber,

said input connection comprises an input connecting member joining said actuator and said input piston, and said output connection comprises an output connecting member joining said output piston and drive ratio adjusting mechanism, and

said means for selectively releasing and securing said input and output connections comprise means releasably securing said input and output connecting members to said input and output pistons, respectively.

7. A rider propelled vehicle according to claim 5 wherein:

said input unit comprises an input cylinder containing an axial bore closed at one end by a cylinder end wall, and a tubular sleeve extending coaxially through said bore from said end wall and radially spaced from the wall of said bore to form between said bore wall and said sleeve an annular space which constitutes said input chamber,

said input member comprises a cup-shaped input piston slidable in said bore and on said sleeve and movable axially through said input chamber, and said input connection comprises an input connecting member extending slidably through said sleeve and joining said piston and said actuator,

said output unit comprises an output cylinder containing an axial bore closed at one end by a cylinder end wall, and a tubular sleeve extending coaxially through said

output cylinder bore from said output cylinder end wall and radially spaced from the wall of said output cylinder bore to form between said output cylinder bore wall and said output cylinder sleeve an annular space which constitutes said output chamber.

said output member comprises a cup-shaped output piston slidable in said output cylinder bore and on said output cylinder sleeve and movable axially through said output chamber, and said output connection comprises an output connecting member extending slidably through said output cylinder sleeve and joining said output piston and said drive ratio adjusting mechanism, and

said means for selectively releasing and securing said input and output connections comprise means releasably securing said input and output connecting members to said input and output pistons, respectively.

8. A rider propelled vehicle according to claim 7 wherein:

said input and output connecting members comprise wire cables.

9. A rider propelled vehicle according to claim 1 wherein:

said vehicular device is a bicycle.

* * * * *

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Yamane

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(45) **Date of Patent: Aug. 21, 2001**

(54) **GRIP FOR A BICYCLE SHIFT CONTROL DEVICE**

(75) Inventor: **Takuro Yamane**, Sakai (JP)

(73) Assignee: **Shimano, Inc.**, Osaka (JP)

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(21) Appl. No.: **09/599,970**

(22) Filed: **Jun. 21, 2000**

Related U.S. Application Data

(62) Division of application No. 08/900,935, filed on Jul. 25, 1997, now Pat. No. 6,101,895.

(51) **Int. Cl.**[7] **B62K 21/26**; B62K 23/04

(52) **U.S. Cl.** **74/551.9**; 74/489

(58) **Field of Search** .... 74/551.9, 489, 74/488, 543; 16/116 R, DIG. 12; 81/177.1, 177.6; D8/303, DIG. 7, DIG. 8

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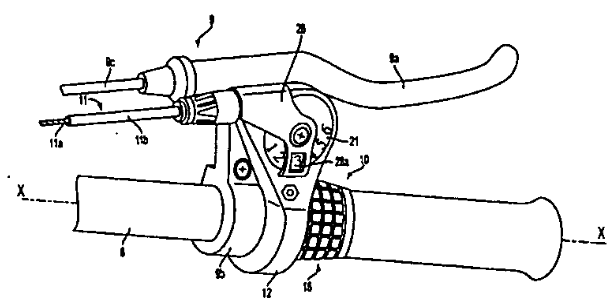
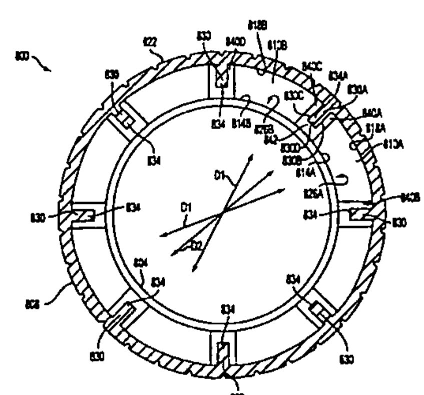
(74) *Attorney, Agent, or Firm*—James A. Deland

(57) **ABSTRACT**

A rotatable handgrip for a twist-grip shift control device includes a rotatable member and a flexible grip disposed over the rotatable member. One or more spaces are defined between an inner peripheral surface of the grip and an outer peripheral surface of the rotatable member so that the grip bends radially inwardly in response to pressure from a hand part (palm, finger, thumb, etc.) so as to generally conform to the hand part. The space may be formed by a recess formed on the inner peripheral surface of the grip, on the outer peripheral surface of the rotatable member, a combination of recesses on the grip and the rotatable member, or through some other structure.

26 Claims, 5 Drawing Sheets





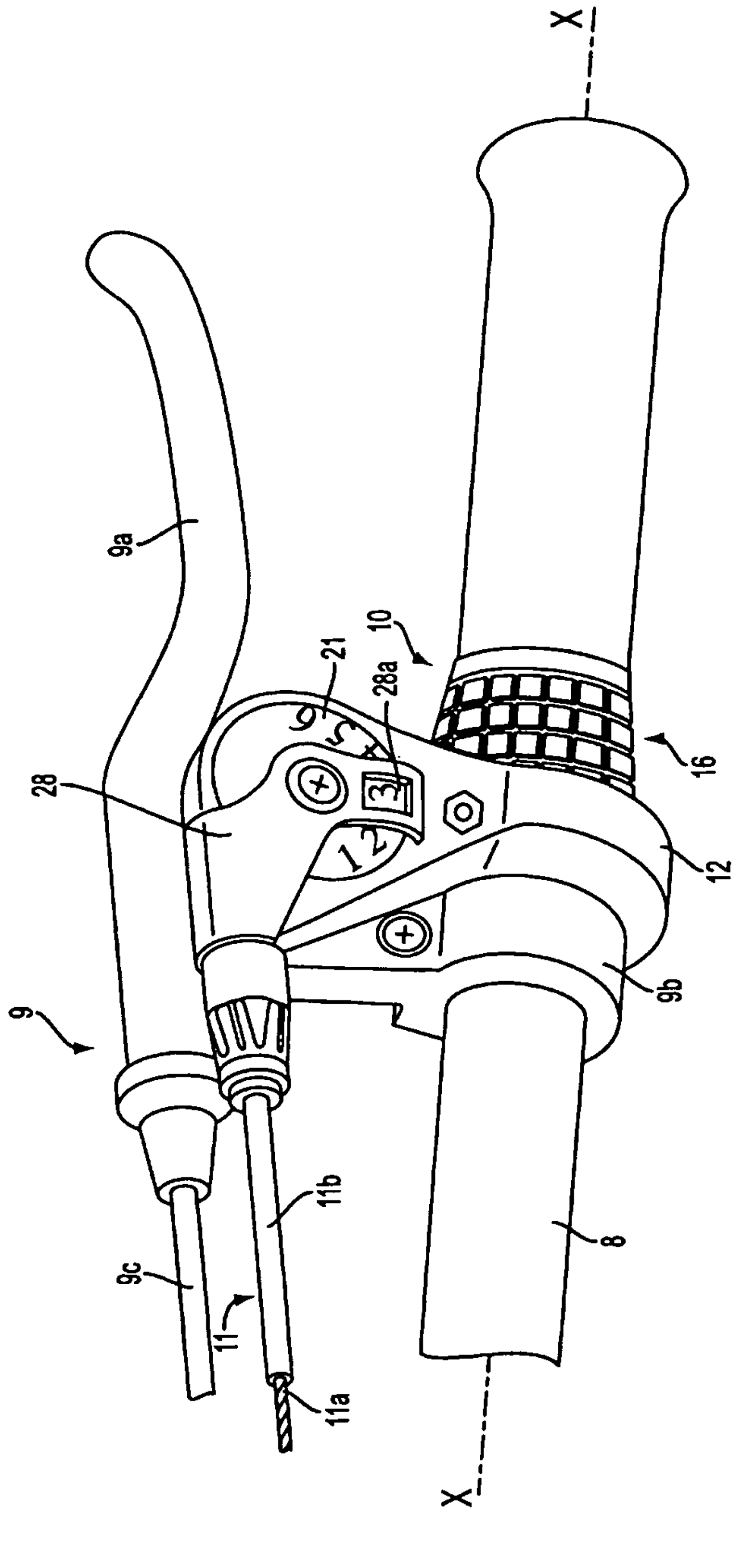


FIG. 1

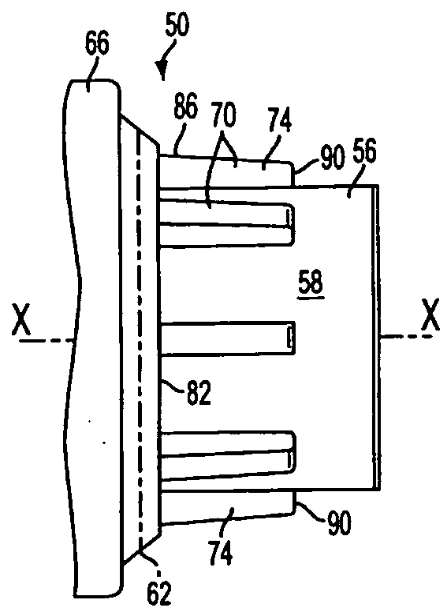


FIG. 2A

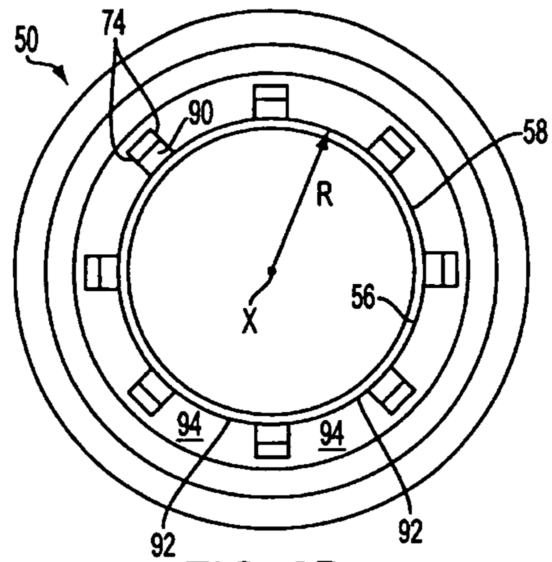


FIG. 2B

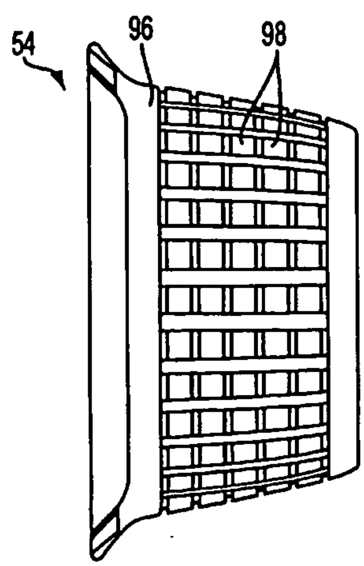


FIG. 3A

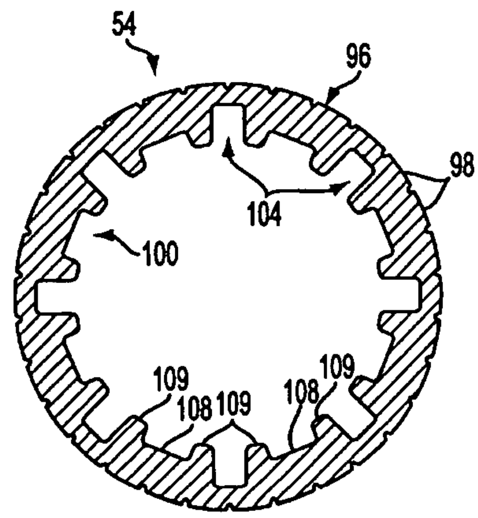
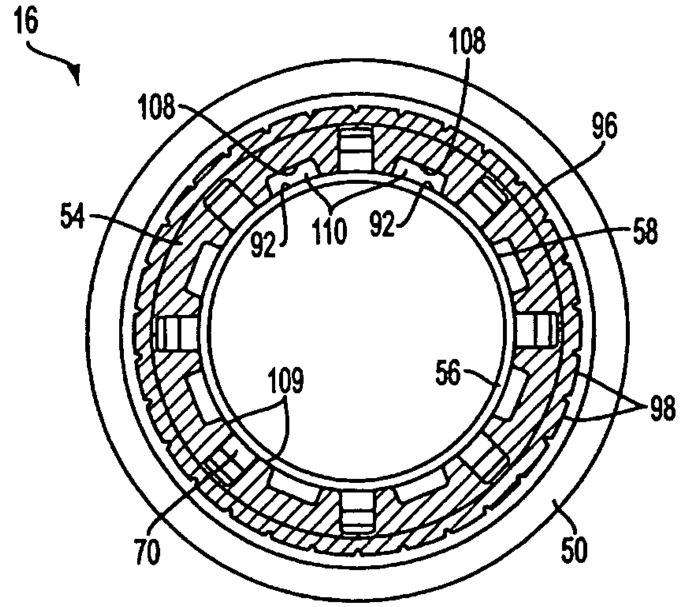


FIG. 3B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108
108
96
54
92
110
92
58
109
56
98
70
50

FIG. 4

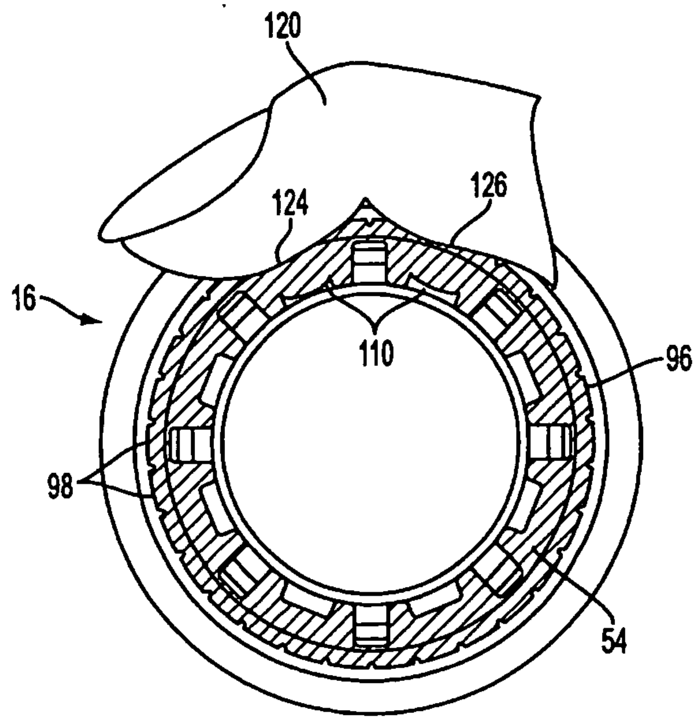
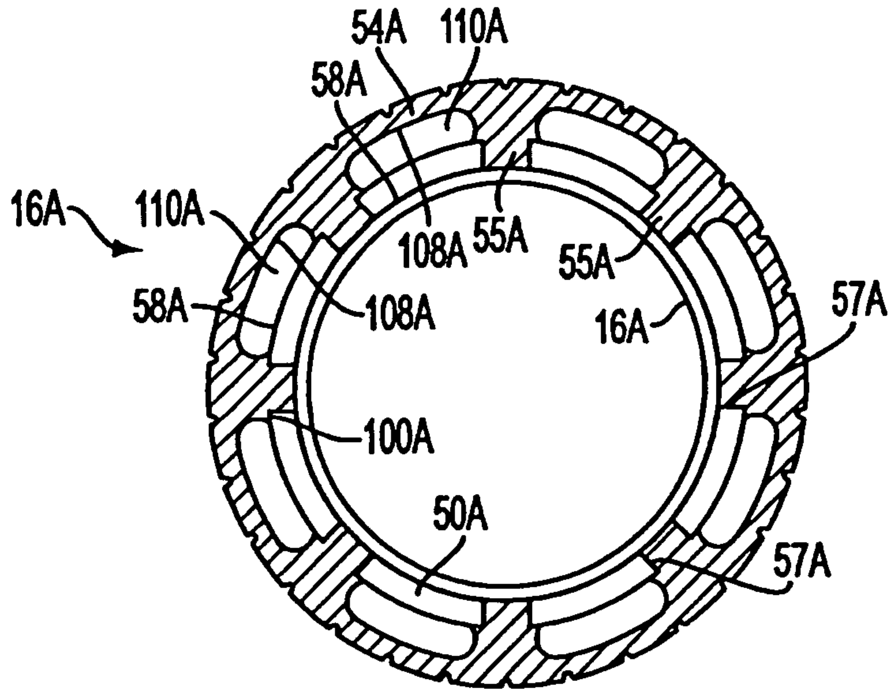

120
124
126
16
110
96
98
54

FIG. 5


54A
110A
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58A
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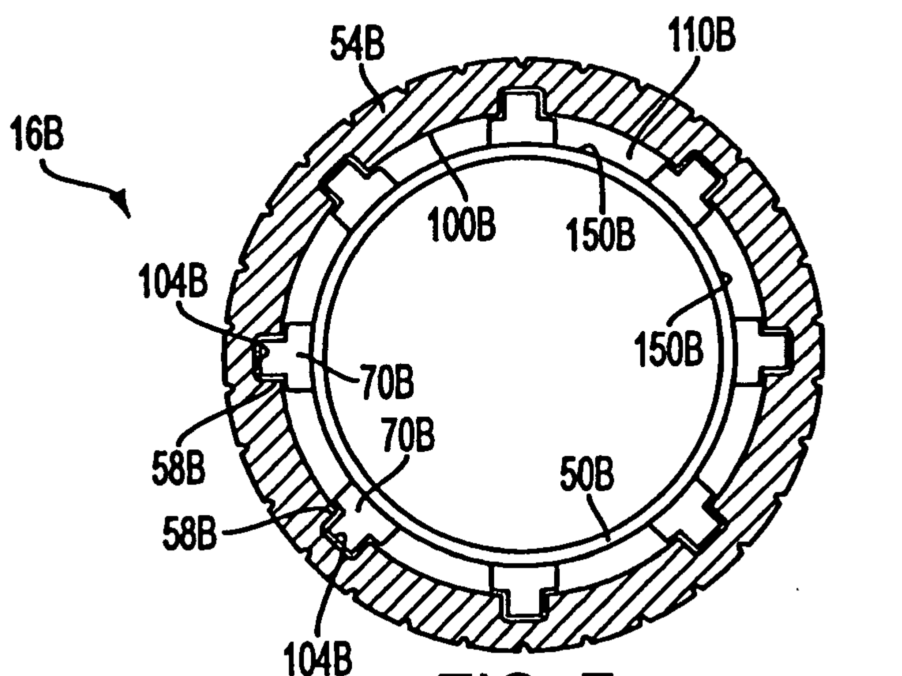
57A
100A
50A
57A

FIG. 6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150B
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58B
70B
50B
58B
104B

FIG. 7

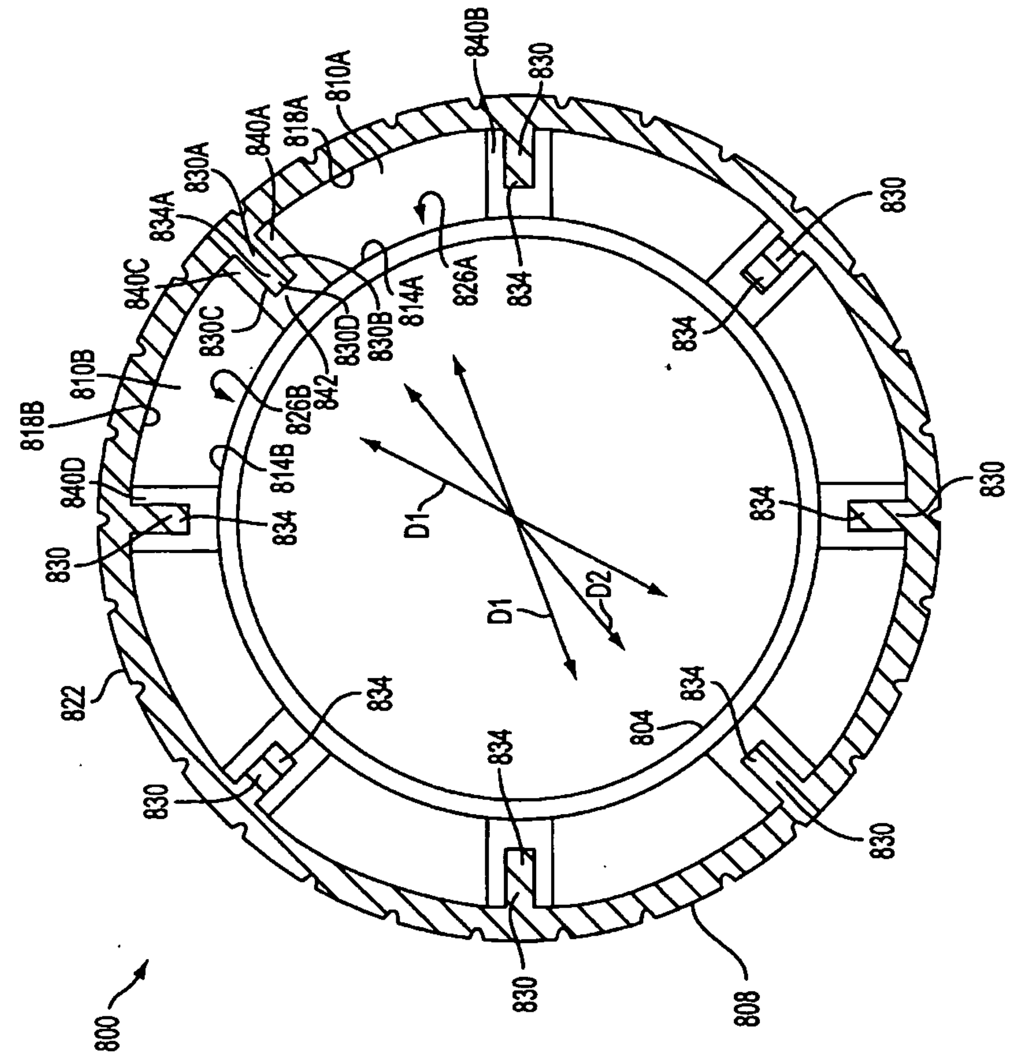
800
808
804
810A
810B
818A
818B
822
826A
826B
830
830A
830B
830C
830D
834
834A
840A
840B
840C
840D
842
814A
814B
D1
D2

FIG. 8

GRIP FOR A BICYCLE SHIFT CONTROL DEVICE

This application is a division of application Ser. No. 08/900,935, filed Jul. 25, 1997, now U.S. Pat. No. 6,101, 895.

BACKGROUND OF THE INVENTION

The present invention is directed to bicycle shift control devices and, more particularly, to a grip for a twist-grip shift control device which conforms more closely to a rider's hand.

Twist-grip shift control devices are sometimes used to control various types of bicycle transmissions. Examples of such devices are disclosed in JP 44-26571; U.S. Pat. Nos. 3,633,437; 4,900,291 and 5,197,927. Such devices typically include a generally annular rotatable member that is mounted around the bicycle handlebar coaxially with the handlebar axis, wherein rotation of the rotatable member with the palm of the hand controls the pulling and releasing of the transmission control cable.

For reliable operation of twist-grip shift control devices, it is desirable to have adequate traction between the palm of the hand and the rotatable member. U.S. Pat. Nos. 5,564,316 and 5,584,213 discuss the use of nubs and elongated ribs on a flexible cover to increase the traction between the hand and the rotatable member. However, while such nubs and ribs may help improve traction, they also tend to jam into the rider's hand, thus creating pain and fatigue.

SUMMARY OF THE INVENTION

The present invention is directed to a rotatable member for a twist-grip shift control device wherein the grip portion of the rotatable member conforms closely to a rider's hand to increase traction between the palm of the hand and the rotatable member, but which significantly decreases the risk of pain and fatigue. In one embodiment of the present invention, a rotatable handgrip for a twist-grip shift control device includes a rotatable member and a flexible grip disposed over the rotatable member. One or more spaces are defined between an inner peripheral surface of the grip and an outer peripheral surface of the rotatable member so that the grip bends radially inwardly in response to pressure from a hand part (palm, finger, thumb, etc.) so as to generally conform to the hand part. The space may be formed by a recess formed on the inner peripheral surface of the grip, on the outer peripheral surface of the rotatable member, a combination of recesses on the grip and the rotatable member, or through some other means. A rotatable grip constructed according to the present invention increases traction between the palm of the hand and the rotatable grip without requiring ribs or nubs. However, the present invention also may be employed advantageously in a handgrip which uses ribs and nubs, because the space between the grip and the rotatable member allow the ribs and nubs to yield to the pressure of the rider's hand. This, in turn, reduces or eliminates the incidences of pain and fatigue.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an oblique view of a particular embodiment of a bicycle twist-grip shift control device according to the present invention mounted together with a brake lever assembly;

FIGS. 2A and 2B are front and side views, respectively, of a particular embodiment of a rotatable member according

to the present invention used in the twist-grip shift control device of FIG. 1;

FIGS. 3A and 3B are front and side views, respectively, of a particular embodiment of a flexible grip according to the present invention that is used with the rotatable member shown in FIGS. 2A and 2B;

FIG. 4 is a side cross sectional view illustrating the flexible grip shown in FIGS. 3A and 3B installed on the rotatable member shown in FIGS. 2A and 2B;

FIG. 5 is a side cross sectional view of the rotatable member and flexible grip illustrating how the flexible grip bends in response to a gripping force exerted by a hand;

FIG. 6 is a side cross sectional view of an alternative embodiment of a rotatable member and flexible grip according to the present invention;

FIG. 7 is a side cross sectional view of another alternative embodiment of a rotatable member and flexible grip according to the present invention; and

FIG. 8 is a side cross sectional view of another alternative embodiment of a rotatable member and flexible grip according to the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

FIG. 1 is an oblique view of a particular embodiment of a twist-grip shift control device **10** according to the present invention mounted together with a brake lever assembly **9**. As shown in FIG. 1, shift control device **10** includes a housing **12** mounted around a handlebar **8**, a rotatable handgrip **16** structured for rotation around an axis X coaxial with handlebar **8**, a pulley **21** for pulling and releasing an inner wire **11*a*** that slides within an outer casing **11*b*** of control cable **11**, and a pulley retaining member **28** for retaining pulley **21** to housing **12**. Pulley retaining member **28** may include a framed opening **28*a*** for selectively displaying a numeral disposed on pulley **21** indicating the currently selected gear. A motion transmitting mechanism (not shown) is disposed between rotatable handgrip **16** and pulley **21** for transmitting rotation of handgrip **16** to pulley **21**. The motion transmitting mechanism may be constructed, for example, according to U.S. Pat. No. 5,921, 139 entitled "Bicycle Shift Control Device" by Takuro Yamane and incorporated herein by reference. Since the motion transmitting mechanism does not form a part of the present invention, a detailed description of that mechanism shall be omitted.

Brake lever assembly **9** includes a brake lever **9*a*** pivotably mounted to a brake lever bracket **9*b*** which, in turn, is mounted around handlebar **8** in close proximity to (e.g., adjacent) housing **12** of shift control device **10**. Brake lever **9*a*** is connected to a brake control cable **9*c*** for controlling a brake device in a conventional manner.

As shown in FIGS. 2A, 2B, 3A, 3B and 4, handgrip **16** includes a rotatable member **50** and a flexible grip **54**. As shown in FIGS. 2A and 2B, rotatable member **50** includes a generally cylindrical main body **56** having an outer peripheral surface **58**; a generally frustoconical intermediate portion **62**, and a larger generally cylindrical portion **66** which interfaces with the motion transmitting mechanism within housing **12**. A plurality of grip engaging members in the form of ribs **70** elongated in the direction of the handlebar axis X extend radially outwardly from outer peripheral surface **58** of main body **56**. In this embodiment, ribs **70** are evenly spaced in the circumferential direction of outer peripheral surface **58**. Each rib includes a pair of side

surfaces 74 that extend from a side surface 82 of frustoconical portion 62 in the direction of the handlebar axis X, and a top surface 86 that inclines slightly radially inwardly from side surface 82 of frustoconical portion 62 to a rib end surface 90 located at an intermediate portion of outer peripheral surface 58. The plurality of ribs 70 define a corresponding plurality of valleys 94 disposed between each pair of adjacent ribs 70, where the bottom floor 92 of each valley 94 is formed by outer peripheral surface 58 of main body 56. In this embodiment, outer peripheral surface 58 has a constant radius of curvature R from handlebar axis X along its entire axial length so that outer peripheral surface 58 has the shape of a straight cylinder. As a result, the floor 92 of each valley 94 likewise has a constant radius of curvature as shown in FIG. 2B.

As shown in FIGS. 3A, 3B, and 4, flexible grip 54 snugly fits around outer peripheral surface 58 of rotatable member 50, and an outer peripheral surface 96 of grip 54 includes a plurality of gripping projections 98 to further facilitate traction between the rider's hand and grip 54 (and hence) rotatable handgrip 16. The inner peripheral surface 100 of grip 54 includes a plurality of rotatable member engaging recesses 104 that are evenly spaced in the circumferential direction of inner peripheral surface 100. Each rotatable member engaging recess 104 is shaped for snugly fitting to a corresponding rib 70 so that grip 54 is nonrotatably secured to rotatable member 50. A plurality of recesses 108 disposed between spaced apart pairs of inner peripheral surface portions 109 likewise are evenly spaced along the inner peripheral surface of grip 54. Each recesses 108 cooperates with a corresponding valley floor 92 for forming a plurality of spaces 110 as shown in FIG. 4. Inner peripheral surface portions 109 are disposed adjacent to their corresponding ribs 70 and contact both the rib 70 and the adjacent valley floor 92 to snugly fit grip 54 to rotatable member 50.

FIG. 5 is a side cross sectional view of the rotatable member 50 and flexible grip 54 illustrating how the flexible grip 54 bends in response to a gripping force exerted by a hand. As shown in FIG. 5, a finger 120 presses radially inwardly to firmly grasp rotatable grip 16. Because of the flexibility of grip 54, the portions of grip 54 disposed over spaces 110 form first and second dents 124 and 126 which conform to finger 120 in response to the radially inwardly directed pressure of finger 120. When further pressure is applied by finger 120, the portions of grip 54 disposed over spaces 110 bend radially inwardly as shown in FIG. 5 for partially or substantially reducing the volume of the corresponding space 110. Because of this yielding nature of grip 54, dents 124 and 126 enhance the traction between the rider's hand and rotatable handgrip 16 by conforming more closely to the rider's hand. Also, there are no sharp edges jamming into the rider's hand as in the prior art rib/nub designs. Furthermore, the yielding nature of grip 54 also cushions the rider's hand to avoid the excessive pressures caused by prior art rib/nub designs, thus further reducing the risk of pain or fatigue.

FIG. 6 is a side cross sectional view of an alternative embodiment of a rotatable handgrip 16A according to the present invention using a different rotatable member 50A and flexible grip 54A. In this embodiment, grip 54A includes a plurality of rotatable member engaging members 55A projecting radially inwardly from the inner peripheral surface 100A. Rotatable member 50A includes a plurality of grip engaging recesses 57A formed in outer peripheral surface 58A, wherein each rotatable member engaging member 55A is disposed in a corresponding grip engaging recess 57A. A plurality of recesses 108A disposed between adjacent pairs of rotatable member engaging members 55A are evenly spaced along the inner peripheral surface 100A of grip 54A. Each recess 108A cooperates with a corresponding portion of the outer peripheral surface 58A of rotatable member 50A for forming a plurality of spaces 100A that function in the same manner as spaces 110 in the first embodiment.

FIG. 7 is a side cross sectional view of another alternative embodiment of a rotatable handgrip 16B according to the present invention using a different rotatable member 50B and flexible grip 54B. As in the first embodiment, the rotatable member 50B includes a plurality of grip engaging members in the form of ribs 70B projecting radially outwardly from the outer peripheral surface 58B, the grip 54B includes a corresponding plurality of rotatable member engaging recess 104B, and each grip engaging member 70B is disposed in a corresponding rotatable member engaging recess 104B. However, in this embodiment, grip 54B does not have recesses corresponding to recesses 108 in the first embodiment. Instead, a plurality of evenly spaced recesses 150 are formed in the outer peripheral surface 58B of rotatable member 50B. Each recess 150 cooperates with the inner peripheral surface 100B of grip 54B for forming a plurality of spaces 110B that function in the same manner as spaces 110 in the first embodiment.

FIG. 8 is a side cross sectional view of an alternative embodiment of a rotatable handgrip 800 according to the present invention using a different rotatable member 804 and flexible grip 808. In this embodiment, a first space 810A is defined between an outer peripheral surface 814A of the rotatable member 804 and an inner peripheral surface 818A of the grip 808 so that the grip 808 bends radially inwardly into the first space 810A to form a first dent (not shown, but similar to dent 126 in FIG. 5) in the outer peripheral surface 822 of the grip in response to pressure from a hand part. A first space-forming recess 826A is formed on the outer peripheral surface 814A of the rotatable member 804 for forming the first space 810A. A second space 810B is defined between an outer peripheral surface 814B of the rotatable member 804 and an inner peripheral surface 818B of the grip 808 so that the grip 808 bends radially inwardly into the second space 810B to form a second dent (not shown, but similar to dent 124 in FIG. 5) in the outer peripheral surface 822 of the grip in response to pressure from the hand part. A second space-forming recess 826B is formed on the outer peripheral surface 814B of the rotatable member 804 for forming the second space 810B.

In general, grip 808 includes a plurality of circumferentially evenly spaced elongated rotatable member engaging members or ribs 830 that engage a corresponding plurality of circumferentially evenly spaced grip engaging recesses 834 to form a plurality of the first spaces 810A and second spaces 810B. For example, the grip 808 includes a rotatable member engaging member 830A projecting radially inwardly from the inner peripheral surfaces 818A and 818B of grip 808, and the rotatable member 804 includes a grip engaging recess 834A, wherein the rotatable member engaging member 830A is disposed in the grip engaging recess 834A, and wherein the rotatable member engaging member 830A is disposed circumferentially between the first space-forming recess 826A and the second space-forming recess 826B. The circumferential width W1 of the grip engaging recess 834A is less than a corresponding circumferential width of the first space-forming recess 826A.

The first space-forming recess 826A is formed between first and second rotatable member projections or sidewalls 840A and 840B extending radially outwardly and forming

an extension of the outer peripheral surface 814A of the rotatable member 804. First and second rotatable member sidewalls 840A and 840B face each other in the circumferential direction, and the first rotatable member sidewall 840A and the second rotatable member sidewall 840B, including radially outermost portions thereof, are disposed clockwise of a first sidewall 830B of the rotatable member engaging member 830A so that the entire first space-forming recess 826A is disposed clockwise of the first sidewall 830B of the rotatable member engaging member 830A. The entire outer peripheral surface 814A of the rotatable member 804 between the first rotatable member sidewall 840A and the second rotatable member sidewall 840B is spaced apart from the inner peripheral surface 818A of grip 808.

Similarly, the second space-forming recess 826B is formed between third and fourth rotatable member projections or sidewalls 840C and 840D extending radially outwardly and forming an extension of the outer peripheral surface 814B of rotatable member 804. Third and fourth rotatable member sidewalls 840C and 840D face each other in the circumferential direction, and the third rotatable member sidewall 840C and the fourth rotatable member sidewall 840D, including radially outermost portions thereof, are disposed counterclockwise of a second sidewall 830C of the rotatable member engaging member 830A so that the entire second space-forming recess 826B is disposed counterclockwise of the second sidewall 830C of the rotatable member engaging member 830A. The entire outer peripheral surface 814B of the rotatable member 804 between the third rotatable member sidewall 840C and the fourth rotatable member sidewall 840D is spaced apart from the inner peripheral surface 818B of grip 808.

Each of the plurality of grip engaging recesses has a radially innermost circumferential outer surface or bottom wall, such as bottom wall 842 that is flat along its entire circumferential width. As shown for rotatable member engaging member 830A, as well as the other rotatable member engaging members 830, each first and second sidewall 830B and 830C and a radially innermost surface or bottom wall 830D of rotatable member engaging member 830A contacts its facing first rotatable member sidewall 840A, third rotatable member sidewall 840C and bottom wall 842. A diameter D1 of an outer peripheral surface 822 of the grip 808 above a circumferential midpoint of the first and second space-forming recess 810A and 810B has a same value as a diameter D2 of the outer peripheral surface 822 of the grip 808 above a circumferential midpoint of the rotatable member engaging member 830A. The same is true for the other space forming recesses and rotatable member engaging members.

While the above is a description of various embodiments of the present invention, further modifications may be employed without departing from the spirit and scope of the present invention. For example, the size, orientation, location and shape of the various components may be changed as desired. Material may be added or removed from the parts as well. Thus, the scope of the invention should not be limited by the specific structures disclosed. Instead, the true scope of the invention should be determined by the following claims. Of course, although labeling symbols are used in the claims in order to facilitate reference to the figures, the present invention is not intended to be limited to the constructions in the appended figures by such labeling.

What is claimed is:

1. A rotatable handgrip for a bicycle shifter comprising:

a rotatable member;

a flexible grip disposed over the rotatable member;

wherein a first space is defined between an inner peripheral surface of the grip and an outer peripheral surface of the rotatable member so that the grip bends radially inwardly into the first space to form a first dent in an outer peripheral surface of the grip in response to pressure from a hand part;

wherein a first space-forming recess is formed on the outer peripheral surface of the rotatable member for forming the first space;

wherein a second space is defined between an inner peripheral surface of the grip and an outer peripheral surface of the rotatable member so that the grip bends radially inwardly into the second space to form a second dent in the outer peripheral surface of the grip in response to pressure from the hand part;

wherein a second space-forming recess is formed on the outer peripheral surface of the rotatable member for forming the second space;

wherein the grip includes a rotatable member engaging member projecting radially inwardly from the inner peripheral surface;

wherein the rotatable member includes a grip engaging recess;

wherein a circumferential width of the grip engaging recess is less than a corresponding circumferential width of the first space-forming recess;

wherein the rotatable member engaging member is disposed in the grip engaging recess;

wherein the rotatable member engaging member is disposed circumferentially between the first space-forming recess and the second space-forming recess;

wherein the first space-forming recess is formed by a first rotatable member sidewall facing a second rotatable member sidewall in a circumferential direction; and

wherein the first rotatable member sidewall and the second rotatable member sidewall are disposed clockwise of a first sidewall of the rotatable member engaging member.

2. The handgrip according to claim 1 wherein substantially all of the rotatable member engaging member contacts the grip engaging recess.

3. The handgrip according to claim 1 wherein radially outermost portions of the first rotatable member sidewall and the second rotatable member sidewall are disposed clockwise of the first sidewall of the rotatable member engaging member.

4. The handgrip according to claim 3 wherein the entire first space-forming recess is disposed clockwise of the first sidewall of the rotatable member engaging member.

5. The handgrip according to claim 1 wherein the second space-forming recess is formed by a third rotatable member sidewall facing a fourth rotatable member sidewall in a circumferential direction, and wherein the third rotatable member sidewall and the fourth rotatable member sidewall are disposed counterclockwise of a second sidewall of the rotatable member engaging member.

6. The handgrip according to claim 5 wherein the grip engaging recess has a radially innermost circumferential outer surface that is flat along its entire circumferential width.

7. The handgrip according to claim 5 wherein radially outermost portions of the first rotatable member sidewall and the second rotatable member sidewall are disposed clockwise of the first sidewall of the rotatable member engaging member, and wherein radially outermost portions

of the third rotatable member sidewall and the fourth rotatable member sidewall are disposed counterclockwise of the second sidewall of the rotatable member engaging member.

8. The handgrip according to claim 7 wherein the entire first space-forming recess is deposed clockwise of the first sidewall of the rotatable member engaging member, and wherein the entire second space-forming recess is disposed counterclockwise of the second sidewall of the rotatable member engaging member.

9. The handgrip according to claim 5 wherein the rotatable member includes:

a plurality of the first-space forming recesses;

a plurality of the second space forming recesses; and

a plurality of the grip engaging recesses;

wherein the grip includes a plurality of elongated ribs forming a plurality of the rotatable member engaging members; and

wherein each of the plurality of ribs is disposed in a corresponding one of the plurality of grip engaging recesses.

10. The handgrip according to claim 9 wherein the plurality of ribs are disposed evenly in a circumferential direction along the inner peripheral surface of the grip.

11. The handgrip according to claim 10 wherein the plurality of first-space forming recesses and the plurality of second space-forming recesses are disposed evenly in the circumferential direction along the outer peripheral surface of the rotatable member.

12. A rotatable handgrip for a bicycle shifter comprising:

a rotatable member;

a flexible grip disposed over the rotatable member;

wherein a plurality of first spaces are defined between an inner peripheral surface of the grip and an outer peripheral surface of the rotatable member so that the grip bends radially inwardly into at least one of the plurality of first spaces to form a first dent in an outer peripheral surface of the grip in response to pressure from a hand part;

wherein a plurality of first space-forming recesses are formed on the outer peripheral surface of the rotatable member for forming the plurality of first spaces;

wherein a plurality of second spaces are defined between an inner peripheral surface of the grip and an outer peripheral surface of the rotatable member so that the grip bends radially inwardly into at least one of the plurality of second spaces to form a second dent in the outer peripheral surface of the grip in response to pressure from the hand part;

wherein a plurality of second space-forming recesses are formed on the outer peripheral surface of the rotatable member for forming the plurality of second spaces;

wherein the grip includes a plurality of ribs projecting radially inwardly from the inner peripheral surface;

wherein the rotatable member includes a plurality of grip engaging recesses;

wherein each of the plurality of ribs is disposed in a corresponding one of the plurality of grip engaging recesses;

wherein each rib is disposed circumferentially between one of the plurality of first space-forming recesses and one of the plurality of second space-forming recesses;

wherein each first space-forming recess is formed by a first rotatable member sidewall facing a second rotatable member sidewall in a circumferential direction;

wherein the first rotatable member sidewall and the second rotatable member sidewall are disposed clockwise of a first sidewall of an adjacent rib;

wherein each second space-forming recess is formed by a third rotatable member sidewall facing a fourth rotatable member sidewall in a circumferential direction;

wherein the third rotatable member sidewall and the fourth rotatable member sidewall are disposed counterclockwise of a second sidewall of the adjacent rib; and

wherein only one of the plurality of first space-forming recesses or second space-forming recesses is disposed between each adjacent pair of the plurality of ribs.

13. The handgrip according to claim 12 wherein each of the plurality of grip engaging recesses has a radially innermost circumferential outer surface that is flat along its entire circumferential width.

14. A rotatable handgrip for a bicycle shifter comprising:

a rotatable member;

a flexible grip disposed over the rotatable member;

wherein a first space is defined between an inner peripheral surface of the grip and an outer peripheral surface of the rotatable member so that the grip bends radially inwardly into the first space to form a first dent in an outer peripheral surface of the grip in response to pressure from a hand part;

wherein a first space-forming recess is formed on the outer peripheral surface of the rotatable member for forming the first space;

wherein a second space is defined between an inner peripheral surface of the grip and an outer peripheral surface of the rotatable member so that the grip bends radially inwardly into the second space to form a second dent in the outer peripheral surface of the grip in response to pressure from the hand part;

wherein a second space-forming recess is formed on the outer peripheral surface of the rotatable member for forming the second space;

wherein the grip includes a rotatable member engaging member projecting radially inwardly from the inner peripheral surface;

wherein the rotatable member includes a grip engaging recess;

wherein a circumferential width of the grip engaging recess is less than a corresponding circumferential width of the first space-forming recess;

wherein the rotatable member engaging member is disposed in the grip engaging recess; and

wherein the grip engaging recess has a radially innermost circumferential outer surface that is flat along its entire circumferential width.

15. The hand grip according to claim 14 wherein substantially all of the rotatable member engaging member contacts the grip engaging recess.

16. The handgrip according to claim 14 wherein the rotatable member includes:

a plurality of the first-space forming recesses;

a plurality of the second space forming recesses; and

a plurality of the grip engaging recesses;

wherein the grip includes a plurality of elongated ribs forming a plurality of the rotatable member engaging members; and

wherein each of the plurality of ribs is disposed in a corresponding one of the plurality of grip engaging recesses.

17. The handgrip according to claim 16 wherein the plurality of ribs are disposed evenly in a circumferential direction along the inner peripheral surface of the grip.

18. The handgrip according to claim 17 wherein the plurality of first-space forming recesses and the plurality of second space-forming recesses are disposed evenly in the circumferential direction along the outer peripheral surface of the rotatable member.

19. A rotatable handgrip for a bicycle shifter comprising:

a rotatable member;

a flexible grip disposed over the rotatable member;

wherein a plurality of first spaces are defined between an inner peripheral surface of the grip and an outer peripheral surface of the rotatable member so that the grip bends radially inwardly into at least one of the plurality of first spaces to form a first dent in an outer peripheral surface of the grip in response to pressure from a hand part;

wherein a plurality of first space-forming recesses are formed on the outer peripheral surface of the rotatable member for forming the plurality of first spaces;

wherein a plurality of second spaces are defined between an inner peripheral surface of the grip and an outer peripheral surface of the rotatable member so that the grip bends radially inwardly into at least one of the plurality of second spaces to form a second dent in the outer peripheral surface of the grip in response to pressure from the hand part;

wherein a plurality of second space-forming recesses are formed on the outer peripheral surface of the rotatable member for forming the plurality of second spaces;

wherein the grip includes a plurality of ribs projecting radially inwardly from the inner peripheral surface;

wherein the rotatable member includes a plurality of grip engaging recesses;

wherein each of the plurality of ribs is disposed in a corresponding one of the plurality of grip engaging recesses;

wherein the grip engaging recess has a radially innermost circumferential outer surface that is flat along its entire circumferential width; and

wherein only one of the plurality of first space-forming recesses or second space-forming recesses is disposed between each adjacent pair of the plurality of ribs.

20. A rotatable handgrip for a bicycle shifter comprising:

a rotatable member;

a flexible grip disposed over the rotatable member;

wherein a first space is defined between an inner peripheral surface of the grip and an outer peripheral surface of the rotatable member so that the grip bends radially inwardly into the first space to form a first dent in an outer peripheral surface of the grip in response to pressure from a hand part;

wherein a first space-forming recess is formed on the outer peripheral surface of the rotatable member for forming the first space;

wherein a second space is defined between an inner peripheral surface of the grip and an outer peripheral surface of the rotatable member so that the grip bends radially inwardly into the second space to form a second dent in the outer peripheral surface of the grip in response to pressure from the hand part;

wherein a second space-forming recess is formed on the outer peripheral surface of the rotatable member for forming the second space;

wherein the grip includes a rotatable member engaging member projecting radially inwardly from the inner peripheral surface of the grip;

wherein the rotatable member includes a grip engaging recess;

wherein a circumferential width of the grip engaging recess is less than a corresponding circumferential width of the first space-forming recess;

wherein the rotatable member engaging member is disposed in the grip engaging recess;

wherein the first space-forming recess is formed between first and second rotatable member projections extending radially outwardly from the outer peripheral surface of the rotatable member;

wherein the first and second rotatable member projections are disposed clockwise of a first sidewall of the rotatable member engaging member;

wherein the second space-forming recess is formed between third and fourth rotatable member projections extending radially outwardly from the outer peripheral surface of the rotatable member;

wherein the third and fourth rotatable member projections are disposed counterclockwise of a second sidewall of the rotatable member engaging member; and

wherein a diameter of an outer peripheral surface of the grip above the first space-forming recess and the second space-forming recess has a same value as a diameter of the outer peripheral surface of the grip above the rotatable member engaging member.

21. The handgrip according to claim 20 wherein substantially all of the rotatable member engaging member contacts the grip engaging recess.

22. The handgrip according to claim 20 wherein the entire first space-forming recess is disposed clockwise of the first sidewall of the rotatable member engaging member, and wherein the entire second space-forming recess is disposed counterclockwise of the second sidewall of the rotatable member engaging member.

23. The handgrip according to claim 20 wherein the rotatable member includes:

a plurality of the first-space forming recesses;

a plurality of the second space forming recesses; and

a plurality of the grip engaging recesses;

wherein the grip includes a plurality of elongated ribs forming a plurality of the rotatable member engaging members; and

wherein each of the plurality of ribs is disposed in a corresponding one of the plurality of grip engaging recesses;

wherein each of the plurality of ribs is disposed between only one of the plurality of first space-forming recess and only one of the plurality of second space-forming recesses; and

wherein a diameter of an outer peripheral surface of the grip above each first space-forming recess and each second space-forming recess has a same value as a diameter of the outer peripheral surface of the grip above the rib between them.

24. The handgrip according to claim 23 wherein the plurality of ribs are disposed evenly in a circumferential direction along the inner peripheral surface of the grip.

25. The handgrip according to claim 24 wherein the plurality of first-space forming recesses and the plurality of second space-forming recesses are disposed evenly in the

circumferential direction along the outer peripheral surface of the rotatable member.

26. A rotatable handgrip for a bicycle shifter comprising:

a rotatable member;

a flexible grip disposed over the rotatable member;

wherein a plurality of first spaces are defined between an inner peripheral surface of the grip and an outer peripheral surface of the rotatable member so that the grip bends radially inwardly into at least one of the plurality of first spaces to form a first dent in an outer peripheral surface of the grip in response to pressure from a hand part;

wherein a plurality of first space-forming recesses are formed on the outer peripheral surface of the rotatable member for forming the plurality of first spaces;

wherein a plurality of second spaces are defined between an inner peripheral surface of the grip and an outer peripheral surface of the rotatable member so that the grip bends radially inwardly into at least one of the plurality of second spaces to form a second dent in the outer peripheral surface of the grip in response to pressure from the hand part;

wherein a plurality of second space-forming recesses are formed on the outer peripheral surface of the rotatable member for forming the plurality of second spaces;

wherein the grip includes a plurality of ribs projecting radially inwardly from the inner peripheral surface;

wherein the rotatable member includes a plurality of grip engaging recesses;

wherein each of the plurality of ribs is disposed in a corresponding one of the plurality of grip engaging recesses;

wherein each first space-forming recess is formed between first and second rotatable member projections extending radially outwardly from the outer peripheral surface of the rotatable member;

wherein the first and second rotatable member projections are disposed clockwise of a first sidewall of a selected one of the plurality of ribs;

wherein each second space-forming recess is formed between third and fourth rotatable member projections extending radially outwardly from the outer surface of the rotatable member;

wherein the third and fourth rotatable member projections are disposed counterclockwise of a second sidewall of the selected one of the plurality of ribs; and

wherein a diameter of an outer peripheral surface of the grip above each first space-forming recess and each second space-forming recess has a same value as a diameter of the outer peripheral surface of the grip above the rib between them; and

wherein only one of the plurality of first space-forming recesses or second space forming recesses is disposed between each adjacent pair of the plurality of ribs.

* * * * *

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United States Patent [19]

Matsuo

[11] Patent Number: 5,967,937

[45] Date of Patent: Oct. 19, 1999

[54] **MOTORIZED SHIFT ASSIST CONTROL APPARATUS FOR BICYCLE TRANSMISSION**

[75] Inventor: **Nobuyuki Matsuo**, Shimonoseki, Japan

[73] Assignee: **Shimano, Inc.**, Osaka, Japan

[21] Appl. No.: **08/932,825**

[22] Filed: **Sep. 18, 1997**

[30] **Foreign Application Priority Data**

Sep. 24, 1996 [JP] Japan 8-251107

[51] **Int. Cl.**^{6} **F16H 3/44**

[52] **U.S. Cl.** **475/297**; 475/298

[58] **Field of Search** 475/296, 297, 475/298, 299, 149

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Primary Examiner—Khoi Q. Ta

Attorney, Agent, or Firm—James A. Deland

[57] **ABSTRACT**

A shift control device for a bicycle transmission having a plurality of transmission paths includes a hub shaft, a driver rotatably mounted around the hub shaft for rotating in first and second directions, wherein the first direction is opposite the second direction, a transmission path selecting member for selecting among the plurality of transmission paths, and a reverse motion mechanism coupled to the driver for converting rotation of the driver in the first direction into motion in the second direction. An operation mechanism operates the transmission path selecting member, wherein the operation mechanism includes a first drive force takeoff component which moves between a first state and a second state. The first drive force takeoff component engages the reverse motion mechanism when the first drive force takeoff component is in the first state for communicating motion of the reverse motion mechanism in the second direction to the transmission path selecting member, and the first drive force takeoff component is disengaged from the reverse motion mechanism when the first drive force takeoff component is in the second state.

20 Claims, 9 Drawing Sheets

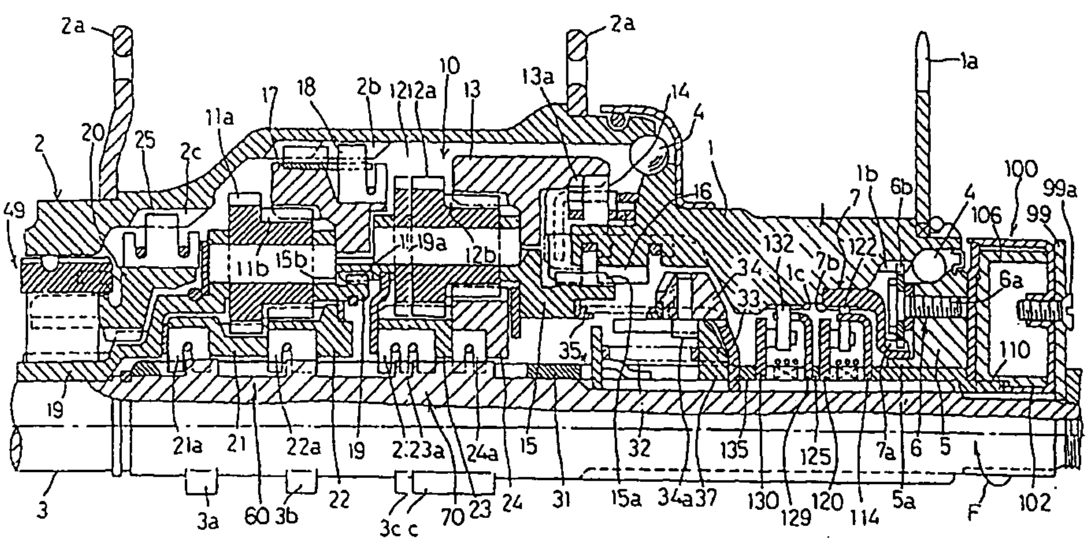


FIG. 1(A)

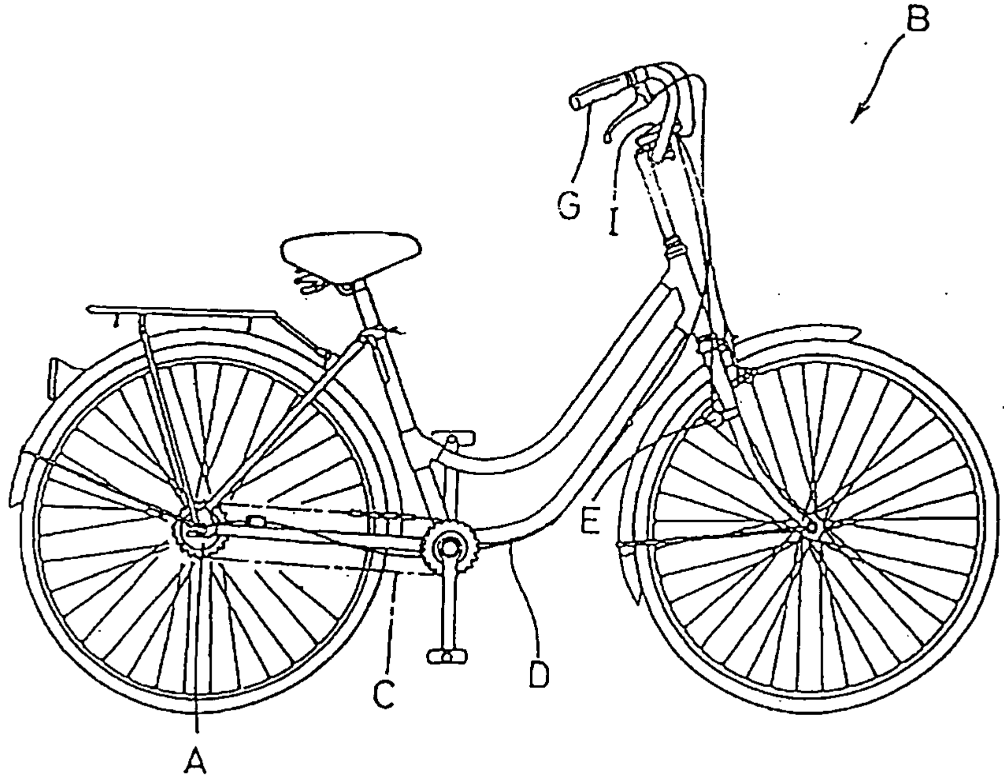


FIG. 1(B)

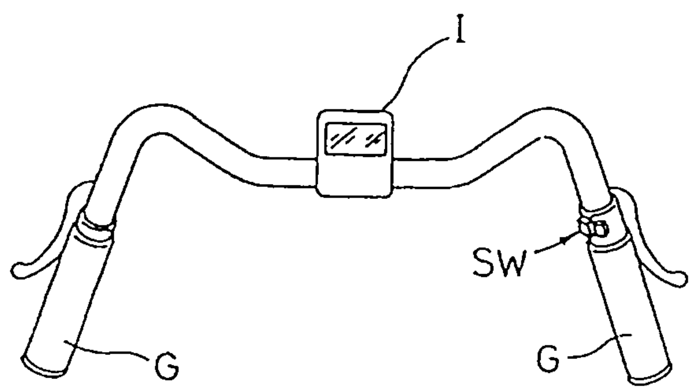
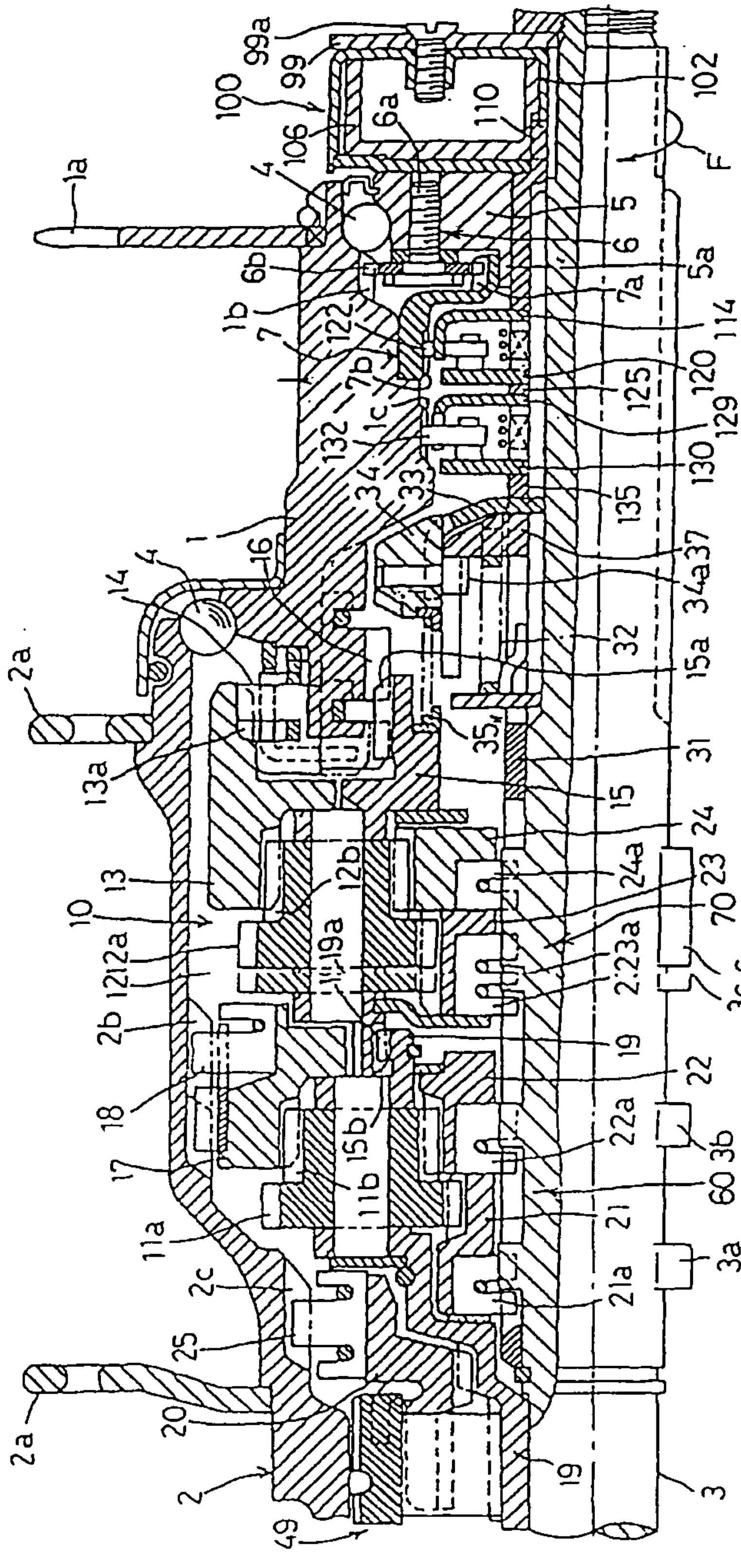


FIG. 2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1b
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7b
120
1c
125
132
129
130
34
33
135
1
37
16
34a
4
14
32
2a
15a
35
13a
31
15
24
24a
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12b
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23a
3c
2b
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18
22
15b
22a
3b
17
11b
60
21
11a
3a
2c
21a
25
20
2a
19
2
3
49

FIG. 3

Operation position of shift sleeve (31)	Shift step	Clutch pawl (16)	First sun gear pawl (21a)	Second sun gear pawl (22a)	Third sun gear pawl (23a)	Fourth sun gear pawl (24a)
7th speed pos.	7th	in	–	O	–	–
6th speed pos.	6th	in	O	×	–	–
5th speed pos.	5th	out	–	O	O	–
4th speed pos.	4th	in	×	×	–	–
3rd speed pos.	3rd	out	O	×	×	O
2nd speed pos.	2nd	out	×	×	O	–
1st speed pos.	1st	out	×	×	×	O

–: control not needed; O: locked attitude; ×: unlocked attitude

FIG. 4(A)

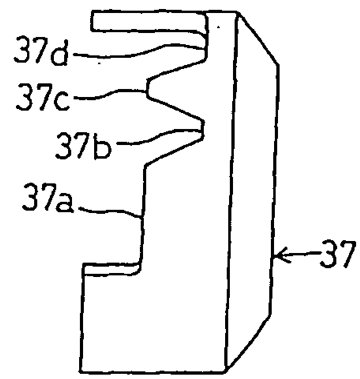


FIG. 4(B)

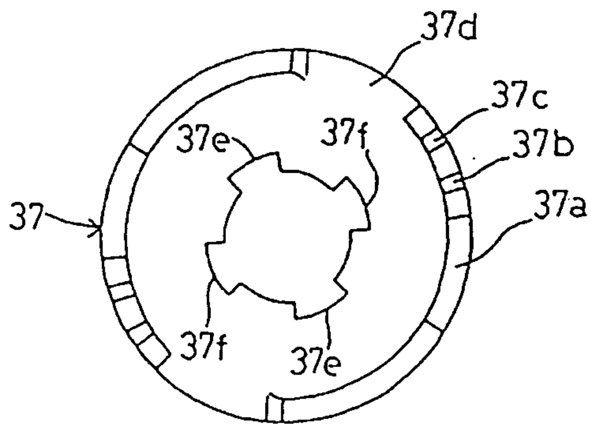


FIG. 5

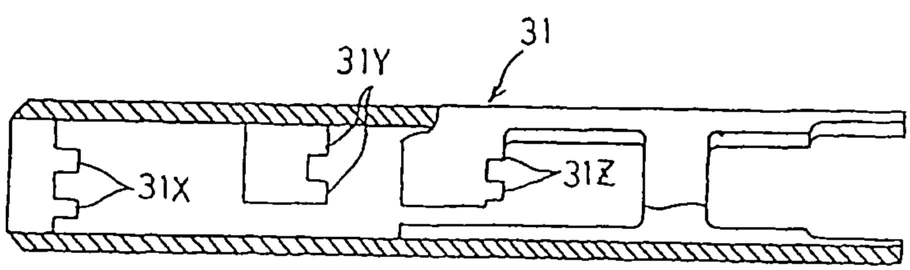


FIG. 6(A)

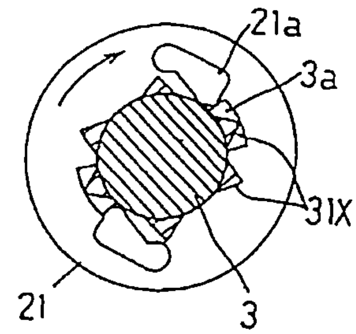
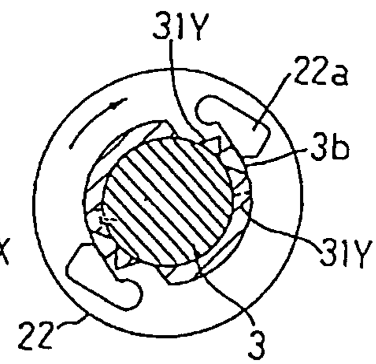


FIG. 6(B)



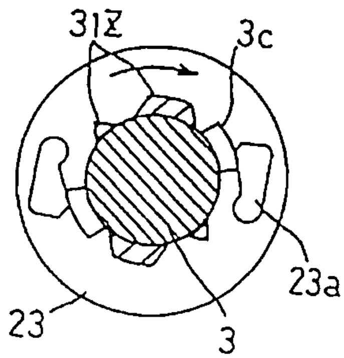


FIG. 6(C)

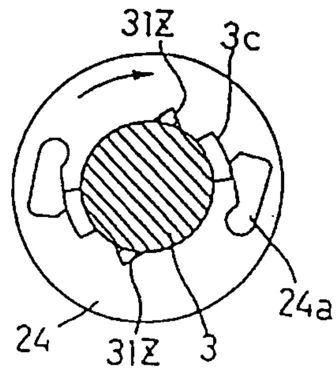
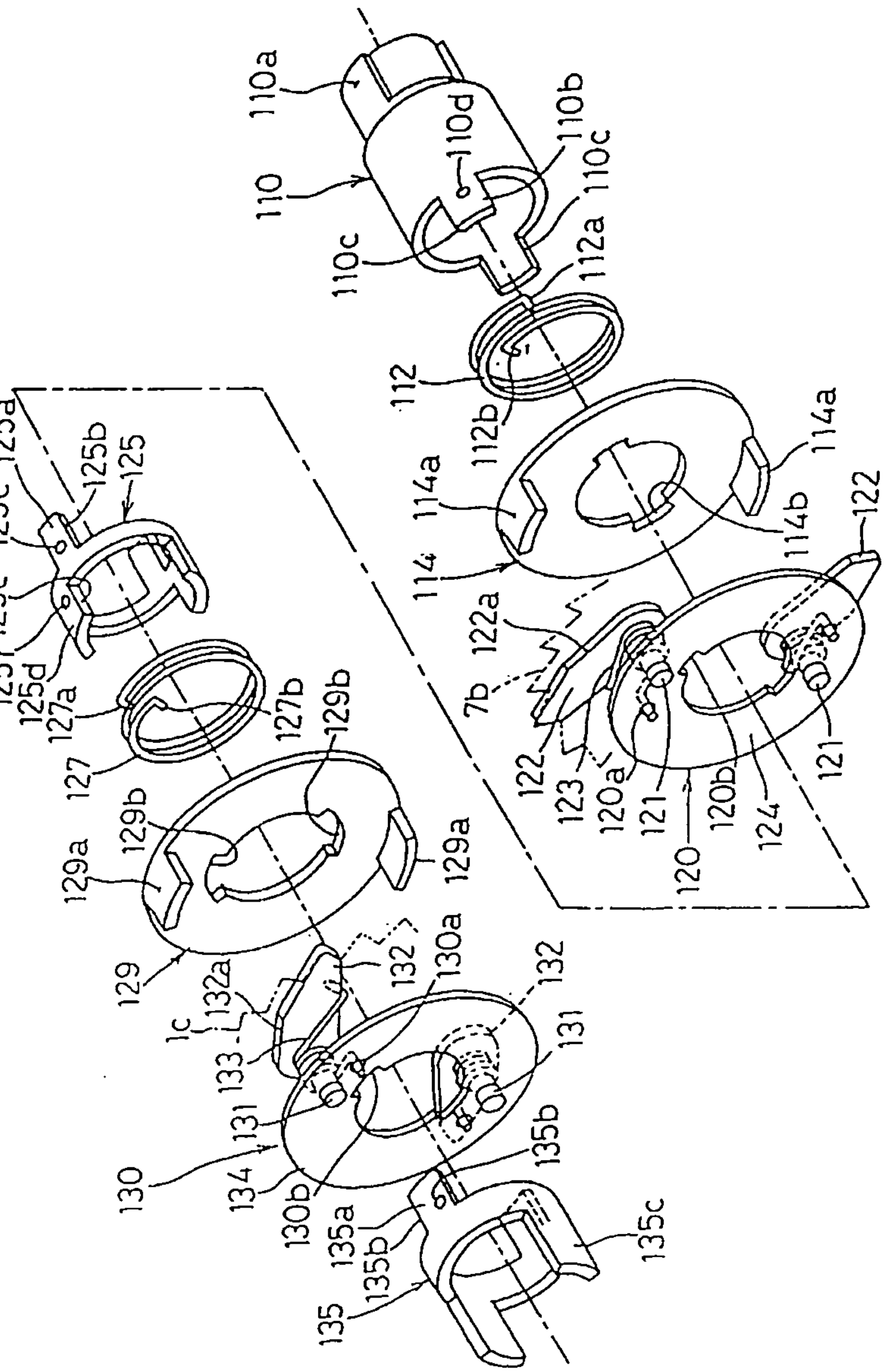


FIG. 6(D)

FIG. 7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120a
121
120
120b
124
121
125a
125b
125
125c
125e
125f
125d
127a
127b
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129b
129b
129a
129a
129
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135a
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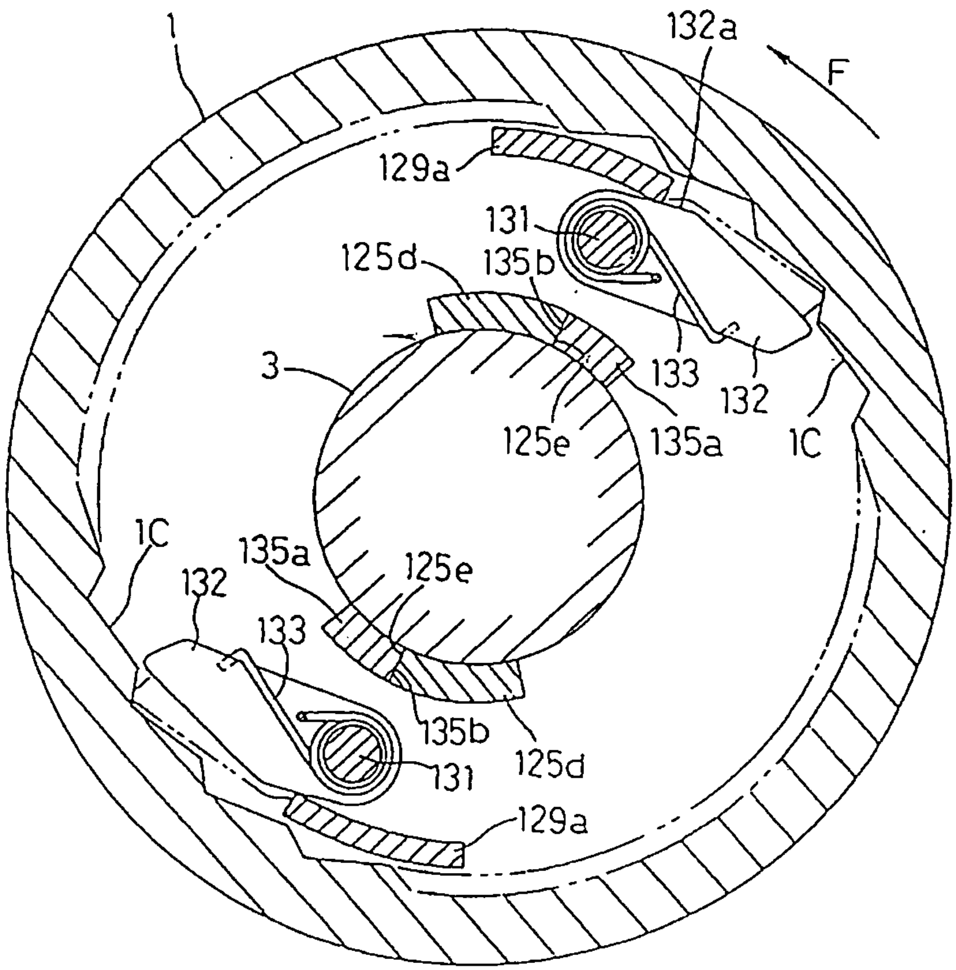
135b
135
135c

FIG. 8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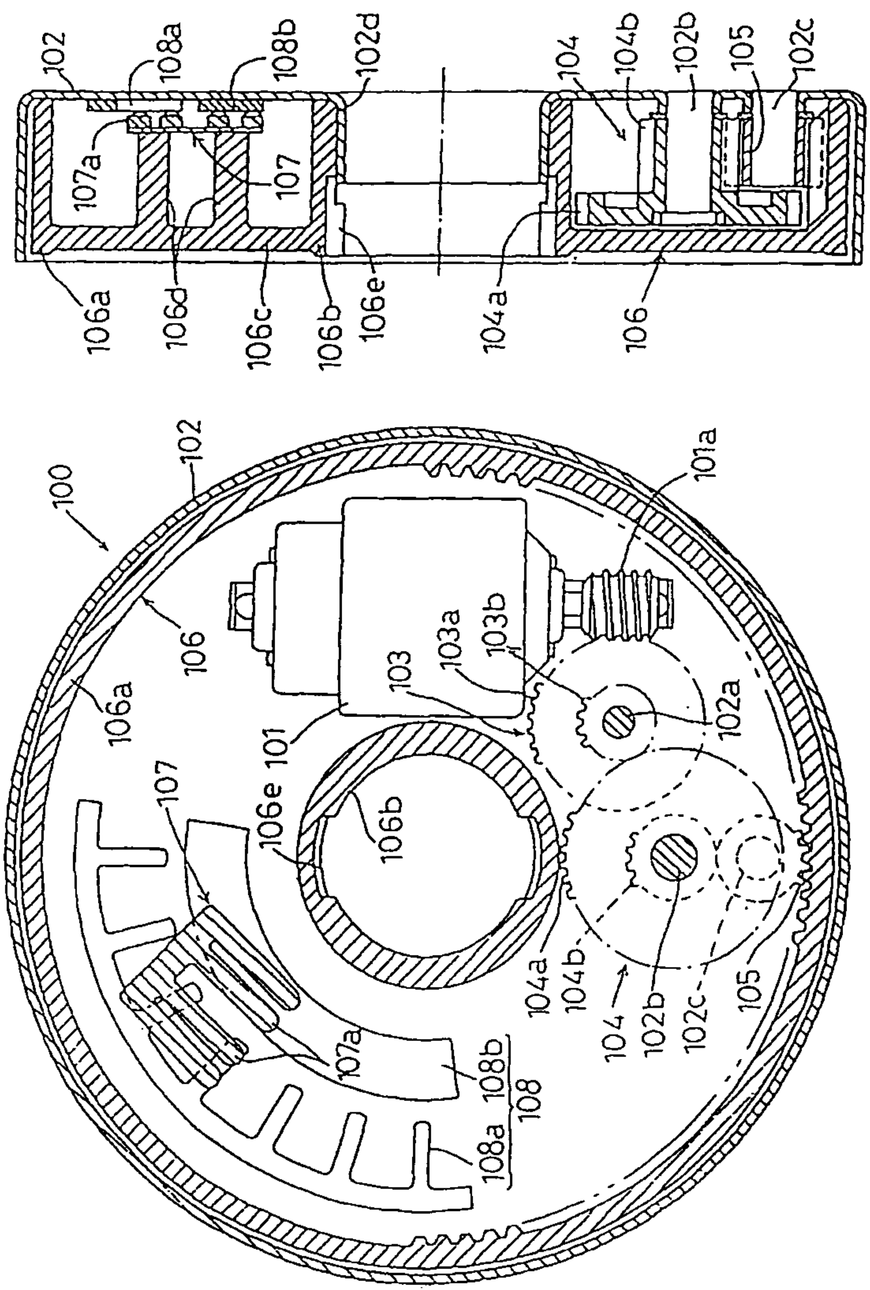
3
133
132
125e
135a
1C
1C
135a
125e
132
133
135b
131
125d
129a

FIG. 9(B)

FIG. 9(A)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103a
103b
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106e
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104b
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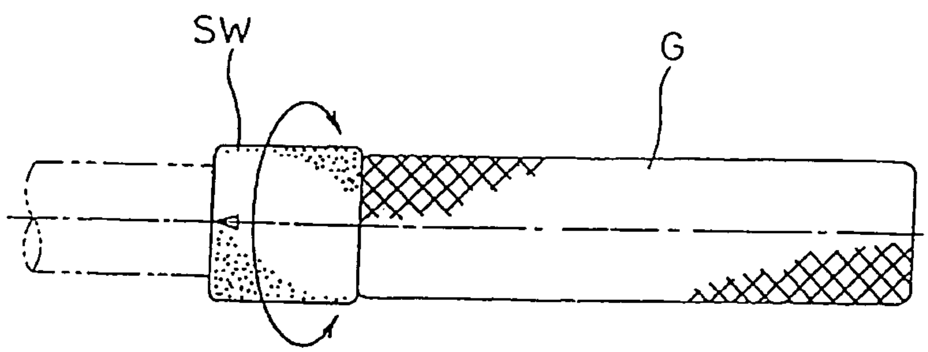
102c
105
107a
108b
108a
108

FIG. 10



MOTORIZED SHIFT ASSIST CONTROL APPARATUS FOR BICYCLE TRANSMISSION

BACKGROUND OF THE INVENTION

The present invention is directed to bicycle transmissions and, more particularly, to bicycle transmissions mounted inside a wheel hub.

Conventional bicycle transmissions can be divided into two types: transmissions that utilize a derailed that is engaged with a chain and that aligns the chain with one of a plurality of gears mounted to a crank or rear wheel of the bicycle, and internal transmissions that are installed in the wheel hub. The apparatus disclosed in Japanese Laid-Open Utility Model Application 57-42792 is an example of an internal transmission. An internal transmission basically makes use of a planet gear mechanism to provide a plurality of shift steps.

The structure of an internal transmission will be described briefly at this point. The important parts in an internal transmission are the fixed shaft that is fixed to the fork of the bicycle, the driver that is rotatably supported on this fixed shaft by bearings or the like and that transmits the drive force from the chain via a gear, and a hub shell that transmits the drive force from the driver via a plurality of drive force transmission routes. The rear wheel is supported on this hub shell via spokes or the like. A planet gear mechanism that forms the plurality of drive force transmission routes is located between the driver and the hub shell. The planet gear mechanism has a sun gear that is provided to the fixed shaft and a planet gear that engages with this sun gear. The planet gear is usually an annular member provided with gear teeth on its outer surface, and it is designed such that it rotates while it revolves with respect to the fixed shaft by means of a gear frame rotatably supported by the fixed shaft. A ring gear that engages with the teeth of the planet gear is often provided radially outwardly from the planet gear. The transmission path through the planet gear mechanism is selected by a clutch that is operated by the rider.

When the bicycle is pedaled, the drive force is transmitted to the driver via the chain and the gear engaged with the chain. The drive force from the driver is transmitted to the planet gear via the gear frame, and when the auto-rotation of this planet gear is transmitted to the hub shell that supports the wheel, the rotation of the driver is accelerated as it is transmitted to the hub shell. When the drive force from the driver is transmitted to the planet gear via the ring gear and is transmitted from the planet gear to the hub shell through the gear frame and the like, the rotation from the driver is decelerated as it is transmitted to the hub shell. Because the clutch must change the path of meshing gears within the planet gear mechanism, a relatively large operating force is sometimes required to operate the clutch. This problem is particularly noticeable when the drive load is heavy, such as when the bicycle is being pedaled hard.

SUMMARY OF THE INVENTION

The present invention is directed to an internally mounted bicycle transmission wherein the shift steps may be selected without requiring an excessive operating force. In one embodiment of the present invention, a shift control device for a bicycle transmission having a plurality of transmission paths includes a hub shaft, a driver rotatably mounted around the hub shaft for rotating in first and second directions, wherein the first direction is opposite the second direction, a transmission path selecting member for selecting among the plurality of transmission paths, and a reverse motion mechanism coupled to the driver for converting rotation of the driver in the first direction into motion in the second direction. An operation mechanism operates the transmission path selecting member, wherein the operation mechanism includes a first drive force takeoff component which moves between a first state and a second state. The first drive force takeoff component engages the reverse motion mechanism when the first drive force takeoff component is in the first state for communicating motion of the reverse motion mechanism in the second direction to the transmission path selecting member, and the first drive force takeoff component is disengaged from the reverse motion mechanism when the first drive force takeoff component is in the second state. Whether the first drive force takeoff component is in the first state or the second state depends upon the required operating force of the transmission path selecting member. If the required operating force of the transmission path selecting member is below a set value (which may be indicative of a light operating force), then the first drive force takeoff component will assume the second state. On the other hand, if the required operating force of the transmission path selecting member is above the set value (which may be indicative of a large operating force), then the first drive force takeoff component will assume the first state, and the motion of the reverse motion mechanism will be used to aid the shifting operation.

In a more specific embodiment, the operation mechanism further includes a second drive force takeoff component that moves between a third state and a fourth state. The second drive force takeoff component engages the driver when the second drive force takeoff component is in the third state for communicating motion of the driver in the first direction to the transmission path selecting member, and the second drive force takeoff component is disengaged from the driver when the second drive force takeoff component is in the fourth state. As with the first drive force takeoff component, whether the second drive force takeoff component is in the third state or the fourth state depends upon the required operating force of the transmission path selecting member. If the required operating force of the transmission path selecting member is below a set value (which again may be indicative of a light operating force), then the second drive force takeoff component will assume the fourth state. On the other hand, if the required operating force of the transmission path selecting member is above the set value (which again may be indicative of a large operating force), then the second drive force takeoff component will assume the third state, and the motion of the driver will be used to aid the shifting operation.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A is a side view of a bicycle that employs a particular embodiment of a shift control apparatus for a bicycle transmission according to the present invention;

FIG. 1B is a plan view of the handlebar portion of the bicycle shown in FIG. 1 A;

FIG. 2 is a cross sectional view of a particular embodiment of an internally mounted bicycle transmission according to the present invention;

FIG. 3 is a diagram illustrating the relationship between a selected gear and the state of the sun gear pawls in the transmission shown in FIG. 2;

FIG. 4A is a side view of a particular embodiment of a cam body used in the transmission shown in FIG. 2;

FIG. 4B is a front view of the cam body shown in FIG. 4A;

FIG. 5 is a partial cross sectional view of a particular embodiment of a shift sleeve used in the transmission shown in FIG. 2;

FIG. 6A–6D are cross sectional views illustrating the engagement of the various sun gear pawls with their associated sun gears when the bicycle transmission is set in the sixth speed position;

FIG. 7 is an exploded view of a particular embodiment of a drive force takeoff mechanism used in the transmission shown in FIG. 2;

FIG. 8 is a cross sectional view illustrating the operation of one of the drive force takeoff components shown in FIG. 7;

FIGS. 9A and 9B are front and side cross sectional views, respectively, of a motor drive apparatus used to control the bicycle transmission shown in FIG. 2; and

FIG. 10 is a plan view of an alternative embodiment of a switch used to operate the bicycle transmission shown in FIG. 2.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Overview

FIG. 1A shows a bicycle B equipped at its rear wheel axle with a particular embodiment of an internal transmission A according to the present invention. Bicycle B further comprises a chain C that transmits the drive force from the pedals to the internal transmission A, a switch SW that is installed near the handle grip G and that selects the shift step, a wire D for transmitting the signals from this switch to the internal transmission A, and a sensor E for monitoring the speed of the bicycle. Switch SW is equipped with two buttons lined up in the peripheral direction of the grip G. A shift up is made when one of these buttons is pressed, and a shift down is made when the other button is pressed. Shifts are usually made one gear at a time with switch SW, but it is also possible to make a multi-gear shift by holding the button down for at least a set period of time, such as one second. As shown in FIG. 1B, an indicator I that is battery-operated and that displays the shift step, the speed, or the like is attached near the stem of the handlebar.

FIG. 2 is a cross sectional view of a particular embodiment of an internally mounted bicycle transmission according to the present invention. In this embodiment, which is directed to a seven-speed bicycle transmission, the transmission comprises a driver **1**, which rotationally drives in the drive direction F (hereinafter this direction will also be referred to as clockwise) with a bicycle drive chain wrapped around a gear **1***a*; a hub shell **2** designed such that the spokes (not shown) of the bicycle wheel are linked to a hub flange **2***a*; a fixed shaft **3** that is fixed to the frame of the bicycle; and a planet gear assembly **10** that transmits rotational power from the driver **1** to the hub shell **2**. These components are supported by the fixed shaft **3** such that they can rotate via balls **4** and a hub cone **5**.

Planet Gear Assembly

The planet gear assembly **10** is equipped with two planet gear mechanisms **60** and **70**, and it transmits the rotational force of the driver **1** to the hub shell **2** in seven different shift steps. The first planet gear mechanism **60** is equipped with a first gear frame **19**, and a relay **20** provided in the region of a coaster brake **49** is fitted to first gear frame **19** such that it is incapable of rotation relative to first gear frame **19**. The first and second sun gears **21** and **22** belonging to the first planet gear mechanism **60** are supported such that they can each rotate independently with respect to the fixed shaft **3** and such that they are incapable of movement in the axial direction. The first and second planet gears **11***a* and **11***b* that mesh with these first and second sun gears **21** and **22**, respectively, are formed integrally as a double gear of different diameters, and they are supported by the first gear frame **19**. The second planet gear **11***b* meshes with a first ring gear **17**.

The second planet gear mechanism **70** is equipped with a second gear frame **15** that is splined-engaged with first gear frame **19** such that it is incapable of rotation relative to first gear frame **19**. Third and fourth sun gears **23** and **24** that belong to this second planet gear mechanism **70** are supported such that they can each rotate independently with respect to the fixed shaft **3** and such that they are incapable of movement in the axial direction. The third and fourth planet gears **12***a* and **12***b* that mesh with these third and fourth sun gears **23** and **24**, respectively, are formed integrally as a double gear of different diameters, and they are supported by the second gear frame **15**. The fourth planet gear **12***b* meshes with a second ring gear **13**.

The first ring gear **17** and the relay **20** are used selectively as the output members of the planet gear mechanism **10** to the hub shell **2**, and the second ring gear **13** and the second gear frame **15** are selectively interchanged as the input members from the driver **1**. A one-way clutch is employed in order to achieve selective power transmission between these members. More specifically, a first transmission clutch **25**, which is provided between the relay **20** and the hub shell **2**, and a second transmission clutch **18**, which is provided between the first ring gear **17** and the hub shell **2**, are installed as output one-way clutches, and a third transmission clutch **16**, which is provided between the second gear frame **15** and the driver **1**, and a fourth transmission clutch **14**, which is provided between the second ring gear **13** and the driver **1**, are installed as input one-way clutches. These one-way clutches are each formed as a ratchet pawl that engages with ratchet teeth.

The first through fourth transmission pawls **25**, **18**, **16**, and **14** that function as clutches are constantly biased by springs so that they engage with respectively corresponding transmission teeth **2***c*, **2***b*, **15***a*, and **13***a*. The first transmission pawl **25** is attached to the relay **20**, the second transmission pawl **18** is attached to the first ring gear **17**, and the third and fourth transmission pawls **16** and **14** are attached to the driver **1**. The transmission pawls **25**,**18**,**16**, and **14** are arranged such that the hub shell **2**, the second gear frame **15**, or the second ring gear **13** follows the respective pawl only when the members to which the pawls are attached rotate in the drive direction F, which is indicated by an arrow in FIG. 2.

The fourth transmission pawl **14** is biased by a pawl spring (not shown) to an erect position, and it transmits the rotational force of the driver **1** to the ring gear **13**. Fourth transmission pawl **14** also permits the ring gear **13** to rotate ahead of the driver **1**. The second transmission pawl **18** is biased by a pawl spring (not shown) to an erect position, and it transmits the rotational force of the ring gear **17** to the hub shell **2**. The first transmission pawl **25** is biased by a pawl spring (not shown) to an erect position, and it allows the hub shell **2** to rotate at a higher speed than the relay **20**. First transmission pawl **25** also transmits to the hub shell **2** the rotational force transmitted from the gear frame **19** of the first planet gear **11** to the relay **20**, and it permits the hub shell **2** to rotate ahead of the relay **20**.

The third transmission pawl **16** is biased by a pawl spring (not shown) to an erect position. Third transmission pawl **16** transmits the rotational force of the driver **1** to the gear frame **15** when third transmission pawl **16** is in its erect state, and

it cuts off transmission from the driver **1** to the gear frame **15** when its in a disengaged state. The first gear frame **19** and the second gear frame **15** are meshed and linked so that they rotate integrally by teeth **15b** and **19a** provided to these respective frames. The third transmission pawl **16** meshes over the entire width of the third transmission teeth **15a**, and the third transmission pawl **16** can be moved in and out by a transmission pawl operator **34** (discussed below).

As shown in FIGS. 2 and 6A through 6D, first through fourth sun gear pawls **21a**, **22a**, **23a**, and **24a** are located between the first through fourth sun gears **21**, **22**, **23**, and **24**, and the pawls are attached swingably to the inner periphery of the first through fourth sun gears such that they function as one-way clutches. These sun gear pawls are constantly biased toward the fixed shaft **3**. A first restricting protrusion **3a** that can be engaged with the first sun gear pawl **21a**, a second restricting protrusion **3b** that can be engaged with the second sun gear pawl **22a**, and a third restricting protrusion **3c** that can be engaged with both the third and fourth sun gear pawls **23a** and **24a** are formed on the fixed shaft **3**. The joint action of these sun gear pawls and restricting protrusions prohibits the rotation of the respective sun gears in one direction about the fixed shaft **3**. Here, the first and second sun gear pawls **21a** and **22a** are disposed so as to permit rotation in the opposite direction from the drive direction F with respect to the fixed shaft **3**, whereas the third and fourth sun clutches **23** and **24** are disposed so as to permit rotation in the drive direction F with respect to the fixed shaft **3**. Because the first sun gear **21** has a small diameter, the boss thereof is extended to the left, and the first sun gear pawl **21a** is provided to this extended portion. The freewheeling/fixed control of the sun gears **21**, **22**, **23**, and **24** with respect to the fixed shaft **3** is performed selectively by a shift sleeve **31**, which is described in detail below.

The seven shift steps in this internal transmission are achieved as follows.

As shown in FIG. 3, the transmission is in the seventh speed when the third transmission pawl **16** is engaged, the first sun gear pawl **21a** does not need control, the second sun gear pawl **22a** is in a locked attitude, the third sun gear pawl **23a** does not need control, and the fourth sun gear pawl **24a** does not need control. In this state, the rotational force of the driver **1** is transmitted to the hub shell **2** via the third transmission pawl **16**, the gear frames **15** and **19**, the first planet gear **11**, the ring gear **17**, and the second transmission pawl **18**.

The transmission is in the sixth speed when the third transmission pawl **16** is engaged, 15 the first sun gear pawl **21a** is in a locked attitude, the second sun gear pawl **22a** is in an unlocked attitude, the third sun gear pawl **23a** does not need control, and the fourth sun gear pawl **24a** does not need control. In this state, the rotational force of the driver **1** is transmitted to the hub shell **2** via the third transmission pawl **16**, the gear frames **15** and **19**, the first planet gear **11**, the ring gear **17**, and the second transmission pawl **18**.

The transmission is in the fifth speed when the third transmission pawl **16** is disengaged, the first sun gear pawl **21a** does not need control, the second sun gear pawl **22a** is in a locked attitude, the third sun gear pawl **23a** is in a locked attitude, and the fourth sun gear pawl **24a** does not need control. In this state, the rotational force of the driver **1** is transmitted to the hub shell **2** via the fourth transmission pawl **14**, the ring gear **13**, the second planet gear **12**, the gear frames **15** and **19**, the first planet gear **11**, the ring gear **17**, and the second transmission pawl **18**.

The transmission is in the fourth speed when the third transmission pawl **16** is engaged, the first sun gear pawl **21a** is in an unlocked attitude, the second sun gear pawl **22a** is in an unlocked attitude, the third sun gear pawl **23a** does not need control, and the fourth sun gear pawl **24a** does not need control. In this state, the rotational force of the driver **1** is transmitted to the hub shell **2** via the third transmission pawl **16**, the gear frames **15** and **19**, the rotational power transmitter **20**, and the first transmission pawl **25**.

The transmission is in the third speed when the third transmission pawl **16** is disengaged, the first sun gear pawl **21a** is in a locked attitude, the second sun gear pawl **22a** is in an unlocked attitude, the third sun gear pawl **23a** is in an unlocked attitude, and the fourth sun gear pawl **24a** is in a locked attitude. In this state, the rotational force of the driver **1** is transmitted to the hub shell **2** via the fourth transmission pawl **14**, the ring gear **13**, the second planet gear **12**, the gear frames **15** and **19**, the first planet gear **11**, the ring gear **17**, and the second transmission pawl **18**.

The transmission is in the second speed when the third transmission pawl **16** is disengaged, the first sun gear pawl **21a** is in an unlocked attitude, the second sun gear pawl **22a** is in an unlocked attitude, the third sun gear pawl **23a** is in a locked attitude, and the fourth sun gear pawl **24a** does not need control. In this state, the rotational force of the driver **1** is transmitted to the hub shell **2** via the fourth transmission pawl **14**, the ring gear **13**, the second planet gear **12**, the gear frames **15** and **19**, the rotational power transmitter **20**, and the first transmission pawl **25**.

The transmission is in the first speed when the third transmission pawl **16** is disengaged, the first sun gear pawl **21a** is in an unlocked attitude, the second sun gear pawl **22a** is in an unlocked attitude, the third sun gear pawl **23a** is in an unlocked attitude, and the fourth sun gear pawl **24a** is in a locked attitude. In this state, the rotational force of the driver **1** is transmitted to the hub shell **2** via the fourth transmission pawl **14**, the ring gear **13**, the second planet gear **12**, the gear frames **15** and **19**, the relay **20**, and the first transmission pawl **25**.

Shift Sleeve/Transmission Pawl Operating Mechanism

The internal transmission shown in FIG. 2 includes a shift sleeve **31**, which is fitted to the fixed shaft **3** such that it is capable of forward and backward rotation, a return spring **32** that rotationally energizes the shift sleeve **31** in the backward rotation direction on the inner side of the hub from the hub cone **5**, a transmission pawl operator **34** that is supported by the fixed shaft **3** via a support member **33** near the hub cone **5**, a return spring **35** that acts on this transmission pawl operator **34**, and so on.

The shift sleeve **31** rotates clockwise and counterclockwise about the axis of the fixed shaft **3**. Shift sleeve **31** is switched between seven operating positions, from the first speed position at one rotational stroke end to the seventh speed position at the other rotational stroke end. As shown in FIG. 4B, a pair of depressions **37e**, which receive a pair of protrusions from the shift sleeve **31**, are provided to a cam body **37**, with the fitting being such that integral rotation with the shift sleeve **31** is possible.

When the shift sleeve **31** is at the first through third speed positions, the first striking component **37a** of the cam body **37** strikes the operating pin **34a** of the transmission pawl operator **34**. When this happens, the first striking component **37a** slides the transmission pawl operator **34** toward the third transmission pawl **16** along the guide of the support member **33** against the return spring **35**, and the cam component of the transmission pawl operator **34** strikes the end of the third transmission pawl **16** and lowers the third transmission pawl **16** to the driver side. As a result, the shift sleeve **31** disengages the third transmission pawl **16**.

When the shift sleeve 31 is in the fourth speed position, a second striking component 37*b*, which is the bottom of a notch in the cam body 37, lines up with the operating pin 34*a* of the transmission pawl operator 34. When this happens, the transmission pawl operator 34 slides away from the third transmission pawl 16 because of the operating force produced by the elastic recovery force of the return spring 35, and the third transmission pawl 16 is engaged by the biasing force of the pawl spring. As a result, the shift sleeve 31 engages the third transmission pawl 16.

When the shift sleeve 31 is in the fifth speed position, the third striking component 37*c* of the cam body 37 strikes the operating pin 34*a* and slides the transmission pawl operator 34 toward the third transmission pawl 16 against the return spring 35, and the cam component of the transmission pawl operator 34 strikes the end of the third transmission pawl 16 and lowers the third transmission pawl 16 to the driver side. As a result, the shift sleeve 31 disengages the third transmission pawl 16.

When the shift sleeve 31 is in the sixth and seventh speed positions, a fourth striking component 37*d*, which is the bottom of a notch in the cam body 37, lines up with the operating pin 34*a*, the transmission pawl operator 34 slides away from the third transmission pawl 16 because of the return spring 35, and the third transmission pawl 16 is engaged by the biasing force of the pawl spring. As a result, the shift sleeve 31 engages the third transmission pawl 16.

As shown in FIG. 5, the shift sleeve 31 is equipped with a first control component 31X, a second control component 31Y, and a third control component 31Z at places corresponding to the sun gears 21 through 22. As the shift sleeve 31 rotates, the first control component 31X moves about the fixed shaft axis with respect to the first protrusion 3*a* of the fixed shaft 3, which makes it possible for the first sun gear pawl 21*a* to stop at the first protrusion 3*a*, or makes it possible for the first sun gear pawl 21*a* to ride up and over the first protrusion 3*a* using the first control component 31X as a guide. Additionally, as the shift sleeve 31 rotates, the second control component 31Y moves about the fixed shaft axis with respect to the second protrusion 3*b* of the fixed shaft 3, which makes it possible for the second sun gear pawl 22*a* to stop at the second protrusion 3*b*, or makes it possible for the second sun gear pawl 22*a* to ride up and over the second protrusion 3*b* using the second control component 31Y as a guide. Finally, as the shift sleeve 31 rotates, the third control component 31Z moves about the fixed shaft axis with respect to the third protrusion 3*c* of the fixed shaft 3, which makes it possible for the third sun gear pawl 23*a* to stop at the third protrusion 3*c*, or makes it possible for the third sun gear pawl 23*a* to ride up and over the third protrusion 3*c* using the third control component 31Z as a guide.

When the shift sleeve 31 is in each of the first through seventh speed positions, the sun gear pawls 21*a* through 24*a* are operated by the control components 31X, 31Y, and 31Z so that they do not need control, are in a locked attitude, or are in an unlocked attitude, as shown in FIG. 3. For example, the relationship between the control components of the shift sleeve 31 and the four sun gear pawls when the shift sleeve 31 is in the sixth speed position is shown in FIGS. 6A, 6B, 6C, and 6D, respectively. As is clear from these figures, part of the first control component 31X lines up with the first protrusion 3*a*, the other part of the first control component 31X is away from the first protrusion 3*a*, the first sun gear pawl 21*a* stops at the first protrusion 3*a*, part of the second control component 31Y is located near the second protrusion 3*b*, and the second sun gear pawl 22*a* rides up and over the second protrusion 3*b* using the second control component 31Y as a riding guide. The third and fourth sun gear pawls 23*a* and 24*a* do not need to be controlled since their rotational direction is the freewheeling direction.

Reverse Motion Mechanism

The internal transmission pertaining to the present invention is equipped with a reverse motion mechanism that moves in the opposite rotational direction from the driver 1. As described below, this reverse motion mechanism is made up of a pinion gear 6 and a reverse motion unit 7.

As shown in FIG. 2, the pinion gear 6 is rotatably supported by the hub cone 5, which is fixed to the fixed shaft 3. This pinion gear 6 has a shaft component 6*a* that extends parallel to the fixed shaft 3, and gear teeth 6*b* that rotate integrally with the shaft component 6*a*. These gear teeth 6*b* engage with the gear 1*b* provided to the inner surface on the right end of the driver 1, which results in the displacement of the upper portion of the pinion gear 6 in the same direction as the driver 1. The gear teeth 6*b* located on lower portion of pinion gear 6 are engaged with the reverse motion unit 7.

Reverse motion unit 7 has a tubular small diameter component and large diameter component. A gear 7*a* that engages with the gear teeth 6*b* of the pinion gear 6 is provided on the outer peripheral surface of the small diameter component, and a gear 7*b* that engages with a first drive force takeoff component 120 (described in detail below) is provided on the inner peripheral surface of the large diameter component. A surface that extends perpendicular to the fixed shaft 3 links the small diameter component and large diameter component. Reverse motion unit 7 is rotatably supported by a cylindrical extension 5*a* that extends in the axial direction and is provided to the outer peripheral surface of the hub cone 5. Because reverse motion unit meshes with the gear teeth 6*b* located on the lower portion of pinion gear 6, reverse motion unit 7 rotates in the opposite direction from driver 1.

Operation Mechanism

As discussed above, the transmission disclosed in this embodiment is designed such that all shift steps are obtained by the rotation of the cam body 37 and the shift sleeve 31.

This combination of the cam body 37 and the shift sleeve 31 is called a clutch in this embodiment. The present invention provides a transmission with extremely light operation even when the drive load is heavy, which is accomplished by operating this clutch by an operation mechanism that includes a DC motor 101. The operation mechanism, which is linked to the clutch and operates the clutch by rotating it in the drive direction or in the backpedaling direction, will now be described through reference to FIGS. 2 and 7 through 9.

Motor

First, the motor component 100 will be described. The signal from the switch SW provided near the handle grips is processed by a controller (not shown) that is provided near the motor component 100 and that is electrically linked via the cord D in FIG. 1. The signal from the switch SW corresponds to an up-shift or down-shift. However, if a signal comes in from the switch SW, the controller does not instantly transmit it to the motor 101. Instead, the controller first confirms whether the command signal from the switch SW exceeds the highest speed position or is under the lowest speed position. Therefore, when an up-shift signal is sent from the switch SW despite the fact that the transmission is in the highest speed position, the motor 101 is not driven. This controller drives the motor 101 such that a one-speed shift is made if the switch SW is held down for a specific

length of time or less, and a shift corresponding to a plurality of speeds is made if the switch SW is held down longer than the set time.

The motor 101 is fixed as a whole to the interior of a cylindrical motor case 102. This motor case 102 is itself non-rotatably fixed to the fixed shaft by a fixing plate 99 and a bolt 99*a*. The rotating shaft of the motor 101 faces in the direction perpendicular to the fixed shaft 3, and a brass worm gear 101*a* is attached to the distal end of this rotating shaft. This worm gear 101*a* meshes with the large diameter gear 103*a* of a first gear 103 that rotates about a shaft 102*a* that extends parallel to the fixed shaft 3. Rotating shaft 102*a* is integrally formed such that it extends from one side surface of the motor case 102 toward the other side surface.

The first gear 103 is equipped with a small diameter gear 103*b* that is formed integrally with the large diameter gear 103*a*. This small diameter gear 103*b* is engaged with the large diameter gear 104*a* of a second gear 104, wherein the second gear 104 rotates about a shaft 102*b* provided to the motor case 102 parallel to the fixed shaft 3. This second gear 104 has a small diameter gear 104*b* that is formed integrally with the large diameter gear 104*a*, and this small diameter gear 104*b* is engaged with a third gear 105. The third gear 105 meshes with a gear provided to the inner surface of the outer tube 106*a* of a fourth gear 106. As shown in FIG. 9B, the fourth gear 106 has an inner tube 106*b* that rotates about the fixed shaft 3 and extends parallel to the fixed shaft 3 and an outer tube 106*a* that is concentric with the inner tube 106*b*. These two tubes are integrally linked by a surface 106*c* that extends perpendicular to the fixed shaft 3. The motor case 102 is equipped with a tube 102*d* that goes between the fixed shaft 3 and the inner tube 106*b* of the fourth gear 106.

As shown in FIG. 9B, the first gear 103, second gear 104, and third gear 105 are disposed in the space formed between the outer tube 106*a* and the inner tube 106*b* of the fourth gear 106. The rotational force from the third gear 105 is transmitted via the outer tube 106*a* to the right sleeve 110 shown in FIG. 7, which is linked to the inner tube 106*b*. The rotational speed of the motor 101 is reduced by this plurality of gears, and the reduction ratio should be small enough that a large operating force can be obtained even with a small motor. 1/500 is preferable, and 1/700 is even better if possible.

The motor component 100 is equipped with a shift step sensor having a potentiometer. This potentiometer is linked to the controller and has a first resistor 108*a*, a second resistor 108*b*, and a terminal component 107 comprising four contact terminals 107*a* that electrically connect the first resistor 108*a* and second resistor 108*b*. As shown in FIG. 9B, this terminal component 107 is supported on the fourth gear 106 by a support 106*d* that extends in the axial direction. The first resistor 108*a* and second resistor 108*b* are fixed to the inner surface of the motor case 102.

As shown in FIG. 9A, the first resistor 108*a* is composed of a base that defines a partial arc and a plurality of extensions that extend inward in the radial direction from the base. The plurality of extensions are provided at specific intervals, and correspond to the plurality of speed positions. Therefore, when the fourth gear 106 is rotated by the motor 101, the terminal component 107 moves along with it, and two of the four contact terminals 107*a* come into contact with one of the plurality of extensions. The other two of the contact terminals 107*a* are always in contact with the second resistor. Therefore, if the first and second resistors are connected to one of the poles of a cell, and the terminal component 107 is connected to the other pole, then the resistance will vary depending on whether the terminal component 107 and the first resistor 108*a* are in contact, which is determined by the relative position of the terminal component 107 with respect to the two resistors. This change in the resistance of the potentiometer is sensed by the controller, and the controller detects when the next shift position is reached, and which of the plurality of shift positions has been reached.

Drive Force Takeoff Components

Next, FIG. 7 will be used to describe the drive force takeoff components that take off drive force from the driver 1 when a large operating force is needed to operate the clutch. This drive force takeoff component makes up part of the operation mechanism, and it is interposed between the clutch and the motor component 100.

First, a transmission path control member in the form of a right sleeve 110 is engaged such that it rotates integrally with respect to the inner tube 106*b* of the fourth gear 106 in the motor component 100. This engagement is accomplished by the engagement of a pair of engagement protrusions 110*a* that extend in the axial direction from the right sleeve 110 with a pair of depressions 106*e* provided on the inside diameter side of the inner tube 106*c* shown in FIG. 9. This engagement may be accomplished by any method, such as using a drag clutch, as long as the engagement allows integral rotation. The right sleeve 110 has an overall tubular shape, and it is able to rotate about the fixed shaft 3. Right sleeve 110 also is provided with engagement protrusions 110*b* that engage with the first control component 114 on the opposite side in the axial direction from the engagement protrusions 110*a*. The lateral surfaces in the peripheral direction of these engagement protrusions 110*b* form striking surfaces 110*c* that strike the striking surfaces 125*b* formed on the lateral surfaces in the peripheral direction of the engagement protrusions 125*a* of a middle sleeve 125.

The first control component 114 has an annular body that extends perpendicular to the fixed shaft 3 and a pair of pawl depressors 114*a* that extend in the axial direction of the fixed shaft 3 from the periphery of the body. Engagement grooves 114*b* that go all the way through and in which the engagement protrusions 110*b* of the right sleeve 110 engage are provided to the inner side of the annular body of the first control component 114. Thus, the first control component 114, the right sleeve 110, and the fourth gear 106 of the motor component 100 are designed so as to rotate integrally.

The part drawn to the left of the first control component 114 in FIG. 7 is the first drive force takeoff component 120. This first drive force takeoff component 120 is equipped with a main disk 124 that is provided in its center with a hole through which the fixed shaft 3 passes, and that is supported such that it can rotate freely with respect to the fixed shaft 3.

A first engagement pawl 122 that is used to engage with the reverse motion unit 7 is supported at its end by a pawl support shaft 121 such that it can swing on the disk 124. This engagement pawl 122 is biased radially outwardly by a first biasing mechanism in the form of spring 123, that is, in the direction of engagement with the reverse motion unit 7. One end of the biasing spring 123 engages with the engagement pawl 122, and the other end is engaged with a hole 120*a* provided to the disk 124. The surface located on the outside in the radial direction of the engagement pawl 122 is formed as a sliding surface 122*a* shaped such that it extends at an angle in the radial direction in a first state in which the engagement pawl 122 is engaged with the reverse motion unit 7. When the pawl depressor 114*a* of the first control component 114 strikes this sliding surface 122*a* from the

outside in the radial direction, the engagement pawl 122 is disengaged from the reverse motion unit 7, resulting in a second, non-transmission state.

Engagement grooves 120*b* that engage with the engagement protrusions 125*a* extending in the axial direction from the middle sleeve 125 are formed in the inner peripheral surface of the disk 124 of the first drive force takeoff component 120. As a result of this engagement, the first drive force takeoff component 120 and the middle sleeve 125 rotate integrally.

The middle sleeve 125 has an overall tubular shape, and it is able to rotate about the fixed shaft 3. Middle sleeve 125 is provided with engagement protrusions 125*d* that engage with a second control component 129 on the opposite side in the axial direction from the engagement protrusions 125*a*. The lateral surfaces in the peripheral direction of these engagement protrusions 125*d* form striking surfaces 125*e* that strike the striking surfaces 135*b* formed on the lateral surfaces in the peripheral direction of the engagement protrusions 135*a* of a transmission path selecting member in the form of a left sleeve 135.

The second control component 129 is formed in the same manner as the first control component 114. Second control component 129 has an annular body that extends perpendicular to the fixed shaft 3 and a pair of pawl depressors 129*a* that extend in the axial direction of the fixed shaft 3 from the periphery of the body. Engagement grooves 129*b* that go all the way through and in which the engagement protrusions 125*d* of the middle sleeve 125 engage are provided to the inner peripheral surface of the annular body of the second control component 129. Thus, the first drive force takeoff component 120, the middle sleeve 125, and the second control component 129 are designed so as to rotate integrally.

The part drawn to the left of the second control component 129 in FIG. 7 is the second drive force takeoff component 130. This second drive force takeoff component 130 is equipped with a main disk 134 that is provided in its center with a hole through which the fixed shaft 3 passes, and that is supported such that it can rotate freely with respect to the fixed shaft 3. A second engagement pawl 132 that is used to engage with the gear 1*c* provided to the inner peripheral surface of the driver 1 is supported at its end by a pawl support shaft 131 such that it can swing on the disk 134. This engagement pawl 132 is biased radially outwardly by a second biasing mechanism in the form of a spring 133, that is, in the direction of engagement with the driver 1. One end of the biasing spring 133 engages with the engagement pawl 132, and the other end is engaged with a hole 130*a* provided to the disk 134. The surface located on the outside in the radial direction of the engagement pawl 132 is formed as a sliding surface 132*a* shaped such that it extends at an angle in the radial direction in a third state in which the engagement pawl 132 is engaged with the driver 1. As shown in FIG. 8, when the pawl depressor 129*a* of the second control component 129 strikes this sliding surface 132*a* from the outside in the radial direction, the engagement pawl 132 is disengaged from the driver 1 in a fourth, non-transmission state.

Engagement grooves 130*b* that engage with the engagement protrusions 135*a* extending in the axial direction from the left sleeve 135 are formed in the inner peripheral surface of the disk 134 of the second drive force takeoff component 130. As a result of this engagement, the second drive force takeoff component 130 and the left sleeve 135 rotate integrally. The engagement protrusions 135*a* of this left sleeve 135 have striking surfaces 135*b* that strike the surfaces 125*e* extending in the radial direction of the engagement protrusions 125*d* of the middle sleeve 125, and as will be described below, these surfaces are biased in the striking direction by a second saver spring 127. The left sleeve 135 is provided with a pair of stop protrusions 135*c* that are stopped in depressions provided to the inside in the radial direction of the cam body 37 so that the left sleeve 135 will rotate integrally with the clutch.

When there is no operating force from the motor component 100, the pawl depressor 114*a* of the first control component 114 is disposed in a state in which it depresses the engagement pawl 122 of the first drive force takeoff component 120, and the pawl depressor 129*a* of the second control component 129 is disposed in a state in which it depresses the engagement pawl 132 of the second drive force takeoff component 130.

A first elastic coupling mechanism in the form of a first saver spring 112, which is a torsion spring, is provided between the right sleeve 110 and the middle sleeve 125. One end 112*a* of the first saver spring 112 is engaged with a hole 110*d* formed in the engagement protrusion 110*b* of the right sleeve 110, and the other end 112*b* is engaged with a hole 125*c* provided to the engagement protrusion 125*a* of the middle sleeve 125. Similarly, a second elastic coupling mechanism in the form of a second saver spring 127, which is a torsion spring, is provided between the middle sleeve 125 and the left sleeve 135. One end 127*a* of the second saver spring 127 is engaged with a hole 125*f* formed in the engagement protrusion 125*d* of the middle sleeve 125, and the other end 127*b* is engaged with a hole 135*b* provided to the engagement protrusion 135*a* of the left sleeve 135.

The first saver spring 112 and the second saver spring 127 are both assembled in a state in which initial spring force is applied. More specifically, the first saver spring 112 is assembled such that a biasing force in the direction in which the right sleeve 110 and the middle sleeve 125 strike will be at work in a state in which the right sleeve 110 and the middle sleeve 125 are striking the respective striking surfaces 110*c* and 125*c* thereof. Similarly, the second saver spring 127 is assembled such that a similar biasing force will be at work between the respective striking surfaces 125*e* and 135*b* of the middle sleeve 125 and the left sleeve 135. In this practical example, the initial spring force of the first saver spring 112 is roughly the same as the initial spring force of the second saver spring 127, but the initial spring force of the two springs may instead be different.

With the present invention, when the operating force needed to operate the clutch is larger than a set value, the drive force takeoff components are displaced between a transmission state, in which the drive force from the driver 1 is transmitted to the clutch, and a non-transmission state, in which the drive force from the driver 1 is not transmitted to the clutch. This set value will be described using the first drive force takeoff component 120 and the first control component 114 as an example.

As described below, when the drive force from the driver 1 is to be used to aid the shifting operation in the upshifting direction, the motor component 100 must allow the first control component 114 to swing by the required operating angle until the engagement pawl 122 of the first drive force takeoff component 120 engages with the reverse motion unit 7. The operating force needed for this is the sum of adding the product of the spring coefficient and the operating angle of the first saver spring 112 to the initial spring force. This value shall be termed the "set value." The set value must be smaller than the operating force of the motor component 100, but otherwise can be selected as desired. For instance,

this set value may be set extremely low, which allows the clutch to be operated by utilizing the drive force from the driver 1 via the drive force takeoff component at all times during shifting. With this practical example, however, the set value is set close to the operating force of the motor component **100**.

The action of the drive force takeoff component will now be described. In this description, the operating force that is transmitted from the motor component **100** to the right sleeve **110** shall be called the motor operating force. Also, we shall assume that the bicycle B is in a drive state, and that a drive load is applied to the planet gear assembly. In this state, the operating force needed to operate the clutch, and thereby the left sleeve **135**, shall be called the required operating force.

First, an upshift will be described. In this case, the right sleeve **110** is operated by the motor component **100** in the opposite direction from F. If, at this point, the required operating force is smaller than the set value, then the first saver spring **112** and the second saver spring **127** will cause the right sleeve **110**, the middle sleeve **125**, and the left sleeve **135** to rotate integrally, the clutch will be operated, and a shift will be made to the desired shift position. At this point, the first drive force takeoff component **120** is in the second, nontransmission state in which it is not engaged with the reverse motion unit **7**.

If, however, the required operating force is larger than the set value, the right sleeve **110** rotates in the opposite direction from F, but the middle sleeve **125** cannot rotate because the lateral surface of the engagement protrusion strikes that of the left sleeve **135**. Therefore, the right sleeve **110** rotates in the opposite direction from F with respect to the middle sleeve **125** against the biasing force from the first saver spring **112**, which tries to cause the right sleeve **110** and the middle sleeve **125** to rotate integrally. When this happens, the pawl depressor **114***a* of the first control component **114**, which up to now has been holding down the engagement pawl **122** of the first drive force takeoff component **120**, rotates relatively, resulting in a first, transmission state that permits the engagement of the reverse motion unit **7** and the first drive force takeoff component **120**. Accordingly, the drive force from the reverse motion unit **7** in the opposite direction from the driver **1** is transmitted to the clutch via the engagement pawl **122**, the middle sleeve **125**, and the left sleeve **135**, and a shift is made.

As the up-shift is made, the middle sleeve **125** and the left sleeve **135** strike each other at their engagement protrusions, and relative displacement does not occur, so the engagement pawl **133** of the second drive force takeoff component **130** is held down by the pawl depressor **129***a* of the second control component **129**, and a fourth, non-transmission state in which the second ring gear **130** and the driver **1** are not engaged is maintained.

The action of the drive force takeoff components during a downshift will now be described.

Here, the right sleeve **110** is rotated in the direction of F when operated. If the required operating force is smaller than the set value of the saver spring **127**, then the middle sleeve **125** and the right sleeve **110** will be striking each other at their striking protrusions, and so will rotate integrally, and since the left sleeve **135** is linked by the middle sleeve **125** and the second saver spring **127**, it rotates integrally with the middle sleeve **125** as a result of the biasing force, and a shift is made.

However, if the required operating force exceeds the drive operating force, the left sleeve **135** will not move even if the middle sleeve **125** is rotated by the right sleeve **110**, so the middle sleeve **125** rotates in the F direction relative to the left sleeve **135** against the biasing force of the second saver spring **127**. When this happens, the pawl depressor **129***a* of the second control component **129** moves with respect to the engagement pawl **132** of the second drive force takeoff component **130**, which allows for the engagement of the second drive force takeoff component **130** with the driver **1**. Consequently, the drive force of the driver **1** in the F direction is transmitted to the clutch via the engagement pawl **132** and the left sleeve **135**, and a shift is made.

Thus, the operating force that has to be supplied by the bicycle rider can be minimized by utilizing the motor **101** to shift the internal transmission. Furthermore, if the drive force takeoff components are utilized, even if the operating force from the motor component **100** is small, a smooth shift can be made by utilizing the drive force from the driver **1**. With a structure such as this, the motor **101** does not need to be as large, which means that the battery does not need to be as large, so a more compact system can be achieved. Also, the service life of the battery can be extended since not as much power is required.

While the above is a description of various embodiments of the present invention, further modifications may be employed without departing from the spirit and scope of the present invention. For example, the size, shape, location or orientation of the various components may be changed as desired. The functions of one element may be performed by two, and vice versa.

In the above embodiment, an internal bicycle transmission having seven shift positions was described, but the number of shift steps of this internal bicycle transmission may be other than seven. The present invention can also be applied to an internal bicycle transmission having a clutch portion that is rotationally displaced as the mechanism for selecting from among a plurality of drive routes.

In the above embodiment, the clutch was constructed so as to swing about the fixed shaft **3**, but it may also be constructed so as to be displaced in the axial direction of the fixed shaft **3**. In this case, the clutch can be designed to be operated by the provision of a cam face or the like that is angled with respect to the fixed shaft **3** to the clutch operation component.

In the above embodiment, the back-pedaling means was equipped with a reverse motion unit **7** and a pinion gear **6**, and a drive force in the opposite direction from the rotational direction of the driver **1** was obtained by engagement of the first drive force takeoff component **120** with the reverse motion unit **7**, but it is also possible to obtain a drive force in the opposite direction from the driver **1** by direct engagement of the first drive force takeoff component **120** on the fixed shaft **3** side of the pinion gear **6**.

FIG. **10** illustrates another embodiment of the switch SW that selects the shift step. This switch is a grip lever provided such that it can swing about the grip G of the handlebar, has a home position that serves as a starting point, performs an up-shift by swinging in one direction from this home position, and performs a down-shift by swinging in the other direction. When the hand is moved away after each operation, the switch returns to its home position since it is biased in the direction of the home position by a spring.

Thus, the scope of the invention should not be limited by the specific structures disclosed. Instead, the true scope of the invention should be determined by the following claims. Of course, although labeling symbols are used in the claims in order to facilitate reference to the figures, the present invention is not intended to be limited to the constructions in the appended figures by such labeling.

What is claimed is:

1. A shift control apparatus for a bicycle transmission having a plurality of transmission paths comprising:

a hub shaft (3);

a driver (1) rotatably mounted around the hub shaft (3) for rotating in first and second directions, wherein the first direction is opposite the second direction;

a transmission path selecting member (135) for selecting among the plurality of transmission paths;

a reverse motion mechanism (5,6,7) coupled to the driver (1) for converting rotation of the driver (1) in the first direction into motion in the second direction; and

an operation mechanism (110,112,114,120,125,127,129,130) for operating the transmission path selecting member (135), wherein the operation mechanism (110,112,114,120,125,127,129,130) includes a first drive force takeoff component (120) which moves between a first state and a second state, wherein the first drive force takeoff component (120) engages the reverse motion mechanism (5,6,7) when the first drive force takeoff component (120) is in the first state for communicating motion of the reverse motion mechanism (5,6,7) in the second direction to the transmission path selecting member (135), and wherein the first drive force takeoff component (120) is disengaged from the reverse motion mechanism (5,6,7) when the first drive force takeoff component (120) is in the second state.

2. The apparatus according to claim 1 wherein the operation mechanism (110,112,114,120,125,127,129,130) includes a first control component (114) coupled to the first drive force takeoff component (120) for switching the first drive force takeoff component (120) between the first state and the second state.

3. The apparatus according to claim 2 wherein the first drive force takeoff component (120) comprises:

a first engagement pawl (122) for engaging the reverse motion mechanism (5,6,7) when the first drive force takeoff component (120) is in the first state; and

a first biasing mechanism (123) that biases the first engagement pawl (122) toward the reverse motion mechanism (5,6,7).

4. The apparatus according to claim 3 wherein the first control component (114) includes a first pawl depressor (114*a*) which allows the first engagement pawl (122) to engage the reverse motion mechanism (5,6,7) when the first control component (114) switches the first drive force takeoff component (120) into the first state and which prevents the first engagement pawl (122) from engaging the reverse motion mechanism (5,6,7) when the first control component (114) switches the first drive force takeoff component (120) into the second state.

5. The apparatus according to claim 1 wherein the reverse motion mechanism (5,6,7) comprises a reverse motion unit (7) that rotates around the hub shaft (3) in the second direction when the driver (1) rotates in the first direction.

6. The apparatus according to claim 5 wherein the reverse motion mechanism (5,6,7) further comprises:

a fixed member (5) fixed relative to the hub shaft (3); and

a gear (6) rotatably mounted to the fixed member (5), wherein the gear (6) engages the driver (1) and the reverse motion unit (7).

7. The apparatus according to claim 1 wherein the operation mechanism (110,112,114,120,125,127,129,130) further comprises:

a transmission path control member (110);

a first elastic coupling mechanism (112) coupled in a path between the transmission path control member (110) and the transmission path selecting member (135) for exerting a first coupling force having a first set value between the transmission path control member (110) and the transmission path selecting member (135);

wherein the transmission path control member (110) moves relative to the transmission path selecting member (135) so that the first drive force takeoff component (120) assumes the first state when the transmission path control member (110) moves in the second direction and a required operating force of the transmission path selecting member (135) is above the first set value; and

wherein the first drive force takeoff component (120) assumes the second state when the transmission path control member (110) moves in the second direction and the required operating force of the transmission path selecting member (135) is below the first set value.

8. The apparatus according to claim 7 wherein the first drive force takeoff component (120) further comprises:

a first engagement pawl (122) for engaging the reverse motion mechanism (5,6,7) when the first drive force takeoff component (120) is in the first state; and

a first biasing mechanism (123) that biases the first engagement pawl (122) toward the reverse motion mechanism (5,6,7); and

wherein the operation mechanism (110,112,114,120,125,127,129,130) further comprises:

a first control component (114) coupled to the first drive force takeoff component (120) for switching the first drive force takeoff component (120) between the first state and the second state;

wherein the first control component (114) includes a first pawl depressor (114*a*) which allows the first engagement pawl (122) to engage the reverse motion mechanism (6,7) when the first control component (114) switches the first drive force takeoff component (120) into the first state and which prevents the first engagement pawl (122) from engaging the reverse motion mechanism (6,7) when the first control component (114) switches the first drive force takeoff component (120) into the second state; and

wherein the first elastic coupling mechanism (112) comprises a first spring coupled in a path between the transmission path control member (110) and the first control component (114).

9. The apparatus according to claim 7 further comprising a motor (101) for operating the transmission path control member (110).

10. The apparatus according to claim 9 further comprising a switch (SW) for operating the motor (101).

11. The apparatus according to claim 1 wherein the operation mechanism (110,112,114,120,125,127,129,130) further includes a second drive force takeoff component (130) which moves between a third state and a fourth state, wherein the second drive force takeoff component (130) engages the driver (1) when the second drive force takeoff component (130) is in the third state for communicating motion of the driver (130) in the first direction to the transmission path selecting member (135), and wherein the second drive force takeoff component (130) is disengaged from the driver (1) when the second drive force takeoff component (130) is in the fourth state.

12. The apparatus according to claim 11 wherein the operation mechanism (110,112,114,120,125,127,129,130) includes:

a first control component (114) coupled to the first drive force takeoff component (120) for switching the first drive force takeoff component (120) between the first state and the second state; and

a second control component (129) coupled to the second drive force takeoff component (130) for switching the second drive force takeoff component (130) between the third state and the fourth state.

13. The apparatus according to claim 12 wherein the first drive force takeoff component (120) comprises:

a first engagement pawl (122) for engaging the reverse motion mechanism (5,6,7) when the first drive force takeoff component (120) is in the first state; and

a first biasing mechanism (123) that biases the first engagement pawl (122) toward the reverse motion mechanism (5,6,7);

wherein the second drive force takeoff component (130) comprises:

a second engagement pawl (132) for engaging the driver (1) when the second drive force takeoff component (130) is in the third state; and

a second biasing mechanism (133) that biases the second engagement pawl (132) toward the driver (1).

14. The apparatus according to claim 13 wherein the first control component (114) includes a first pawl depressor (114*a*) which allows the first engagement pawl (122) to engage the reverse motion mechanism (5,6,7) when the first control component (114) switches the first drive force takeoff component (120) into the first state and which prevents the first engagement pawl (122) from engaging the reverse motion mechanism (5,6,7) when the first control component (114) switches the first drive force takeoff component (120) into the second state, and wherein the second control component (129) includes a second pawl depressor (129*a*) which allows the second engagement pawl (132) to engage the driver (1) when the second control component (129) switches the second drive force takeoff component (130) into the third state and which prevents the second engagement pawl (132) from engaging the driver (1) when the second control component (129) switches the second drive force takeoff component (130) into the fourth state.

15. The apparatus according to claim 11 wherein the reverse motion mechanism (5,6,7) comprises a reverse motion unit (7) that rotates around the hub shaft (3) in the second direction when the driver (1) rotates in the first direction.

16. The apparatus according to claim 15 wherein the reverse motion mechanism (5,6,7) further comprises:

a fixed member (5) fixed relative to the hub shaft (3); and

a gear (6) rotatably mounted to the fixed member (5), wherein the gear (6) engages the driver (1) and the reverse motion unit (7).

17. The apparatus according to claim 1 wherein the operation mechanism (110,112,114,120,125,127,129,130) further comprises:

a transmission path control member (110);

a first elastic coupling mechanism (112) coupled in a path between the transmission path control member (110) and the transmission path selecting member (135) for exerting a first coupling force having a first set value between the transmission path control member (110) and the transmission path selecting member (135);

wherein the transmission path control member (110) moves relative to the transmission path selecting member (135) so that the first drive force takeoff component (120) assumes the first state when the transmission path control member (110) moves in the second direction and a required operating force of the transmission path selecting member (135) is above the first set value;

wherein the first drive force takeoff component (120) assumes the second state when the transmission path control member (110) moves in the second direction and the required operating force of the transmission path selecting member (135) is below the first set value;

a second elastic coupling mechanism (127) coupled in a path between the transmission path control member (110) and the transmission path selecting member (135) for exerting a second coupling force having a second set value between the transmission path control member (110) and the transmission path selecting member (135);

wherein the transmission path control member (110) moves relative to the transmission path selecting member (135) so that the second drive force takeoff component (130) assumes the third state when the transmission path control member (110) moves in the first direction and the required operating force of the transmission path selecting member (135) is above the second set value; and

wherein the second drive force takeoff component (130) assumes the fourth state when the transmission path control member (110) moves in the first direction and the required operating force of the transmission path selecting member (135) is below the second set value.

18. The apparatus according to claim 17 wherein the first drive force takeoff component (120) further comprises:

a first engagement pawl (122) for engaging the reverse motion mechanism (5,6,7) when the first drive force takeoff component (120) is in the first state; and

a first biasing mechanism (123) that biases the first engagement pawl (122) toward the reverse motion mechanism (5,6,7);

wherein the second drive force takeoff component (130) further comprises:

a second engagement pawl (132) for engaging the driver (1) when the second drive force takeoff component (130) is in the third state; and

a second biasing mechanism (133) that biases the engagement pawl (132) toward the driver (1);

wherein the operation mechanism (110,112,114,120,125,127,129,130) further comprises:

a first control component (114) coupled to the first drive force takeoff component (120) for switching the first drive force takeoff component (120) between the first state and the second state;

wherein the first control component (114) includes a first pawl depressor (114*a*) which allows the first engagement pawl (122) to engage the reverse motion mechanism (6,7) when the first control component (114) switches the first drive force takeoff component (120) into the first state and which prevents the first engagement pawl (122) from engaging the reverse motion mechanism (6,7) when the first control component (114) switches the first drive force takeoff component (120) into the second state;

wherein the first elastic coupling mechanism (112) comprises a first spring coupled in a path between the transmission path control member (110) and the first control component (114);

a second control component (129) coupled to the second drive force takeoff component (130) for

switching the second drive force takeoff component (130) between the third state and the fourth state;

wherein the second control component (129) includes a second pawl depressor (129*a*) which allows the second engagement pawl (132) to engage the driver (1) when the second control component (129) switches the second drive force takeoff component (130) into the third state and which prevents the second engagement pawl (132) from engaging the driver (1) when the second control component (129) switches the second drive force takeoff component (130) into the fourth state; and

wherein the second elastic coupling mechanism (127) comprises a second spring coupled in a path between the transmission path control member (110) and the second control component (129).

19. The apparatus according to claim 17 further comprising a motor (101) for operating the transmission path control member (110).

20. The apparatus according to claim 19 further comprising a switch (SW) for operating the motor (101).

* * * * *

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United States Patent [19]

Kund

[11] **Patent Number: 5,178,033**

[45] **Date of Patent: Jan. 12, 1993**

[54] **BICYCLE GEAR DISPLAY**

[76] Inventor: August Kund, 2238 Calaveras Dr., Camarillo, Calif. 93010

[21] Appl. No.: 753,971

[22] Filed: Sep. 3, 1991

[51] Int. Cl.[5] F16C 1/10

[52] U.S. Cl. .... 74/501.5 R; 74/502.2; 74/489; 74/422; 74/DIG. 7; 116/28.1; 116/317; 280/288.4

[58] Field of Search .... 74/501.5 R, 502.2, 488, 74/489, 502, 503, DIG. 7, 89.17, 422; 116/28.1, 300, 317, DIG. 20; 280/288.4

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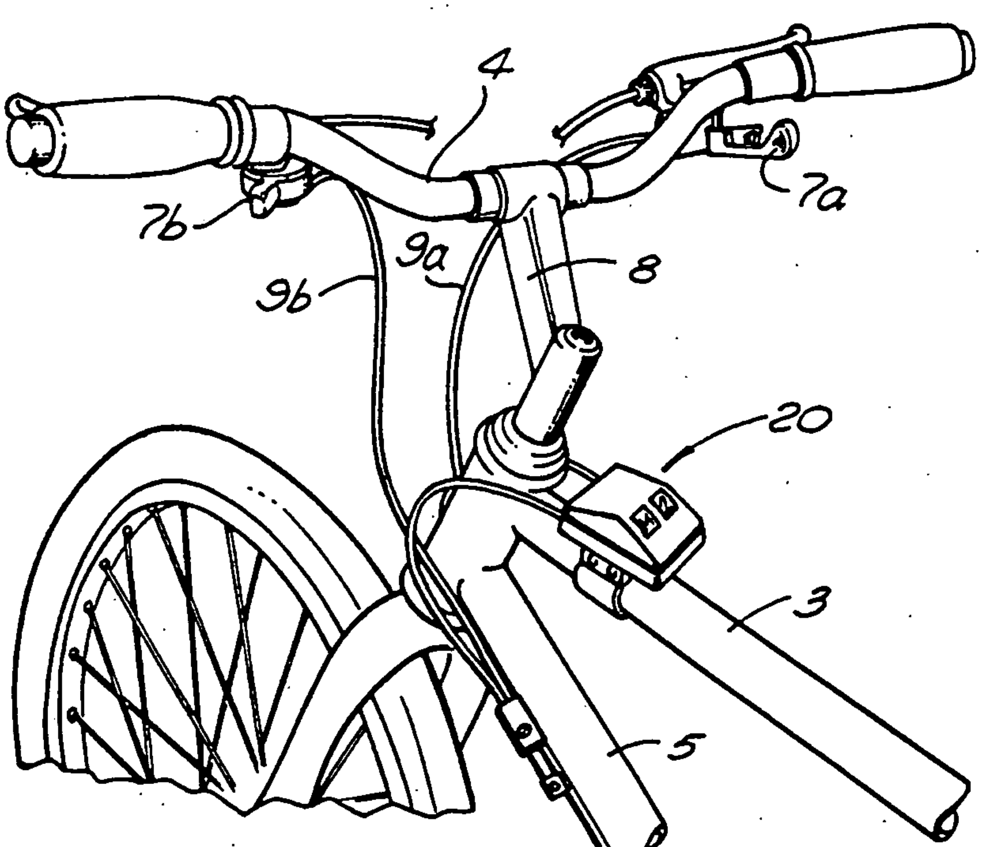
Primary Examiner—Richard Lorence
Assistant Examiner—Andrea Pitts
Attorney, Agent, or Firm—Blakely, Sokoloff, Taylor & Zafman

[57] **ABSTRACT**

A display device for use on a multi-speed (multi-gear) bicycle, which indicates the currently selected bicycle gear. The device interfaces directly with a gear changing cable. In one embodiment, a toothed rack is attached to a section of cable running along the bicycle frame. A pinion, attached to a cylindrical indicator meshes with the rack. In an embodiment for remote mounting, a slave cable is attached to the gear changing cable to transmit the motion of the gear changing cable to the remote location.

20 Claims, 6 Drawing Sheets



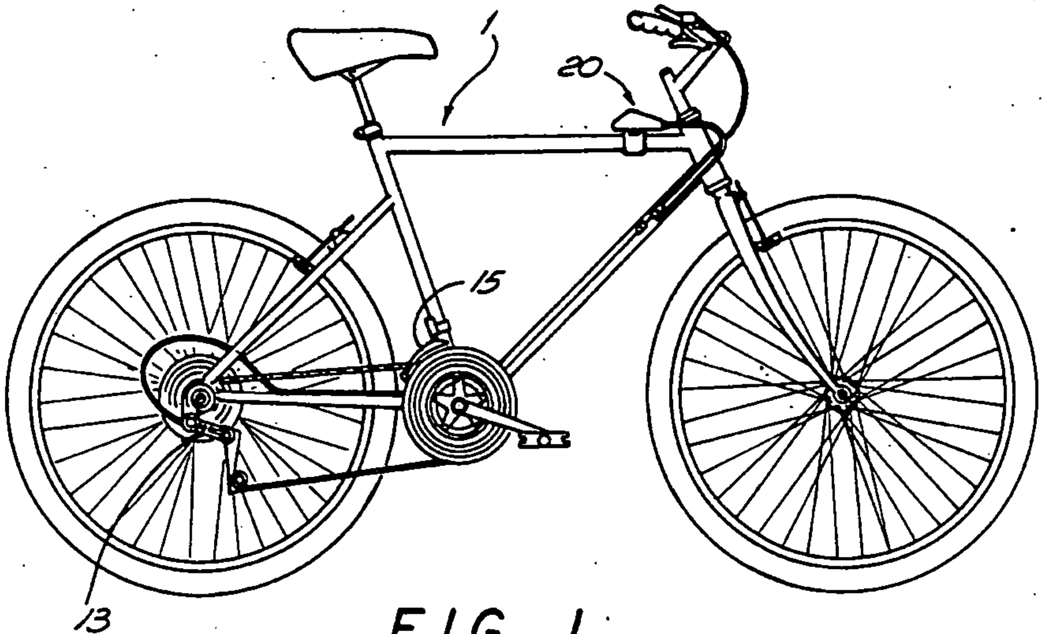


FIG. 1

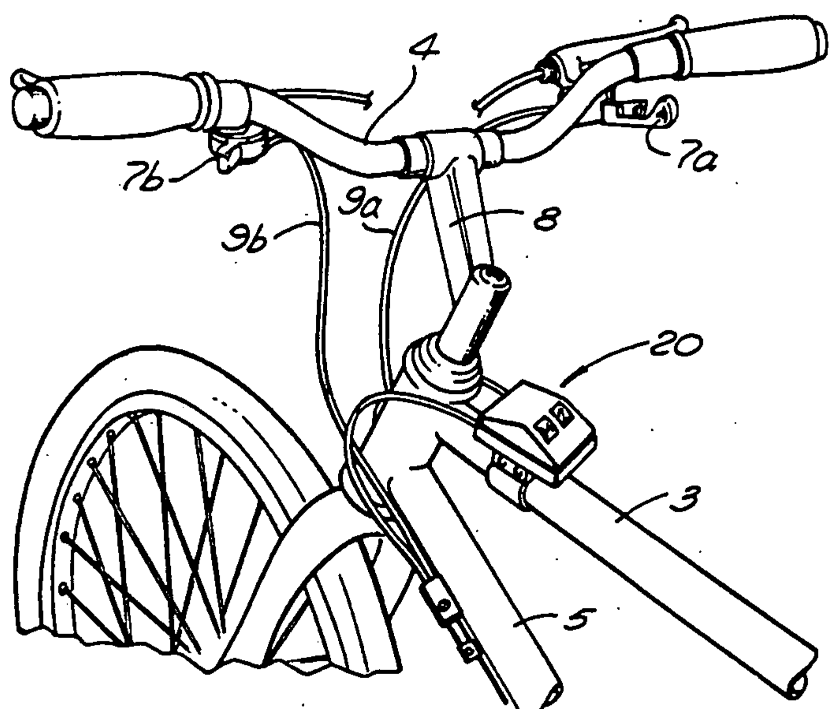


FIG. 2

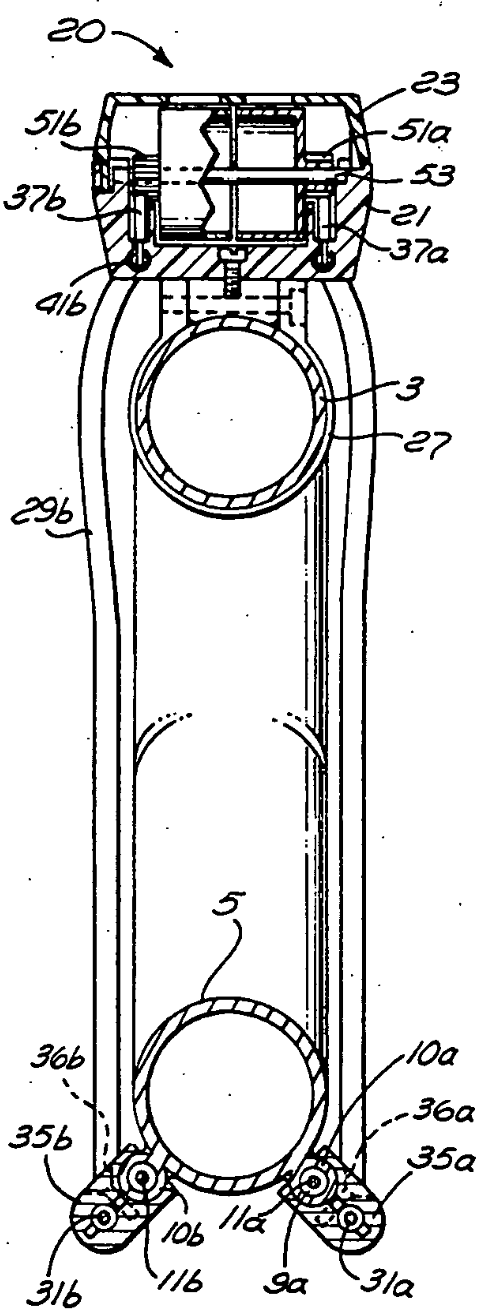


FIG. 4

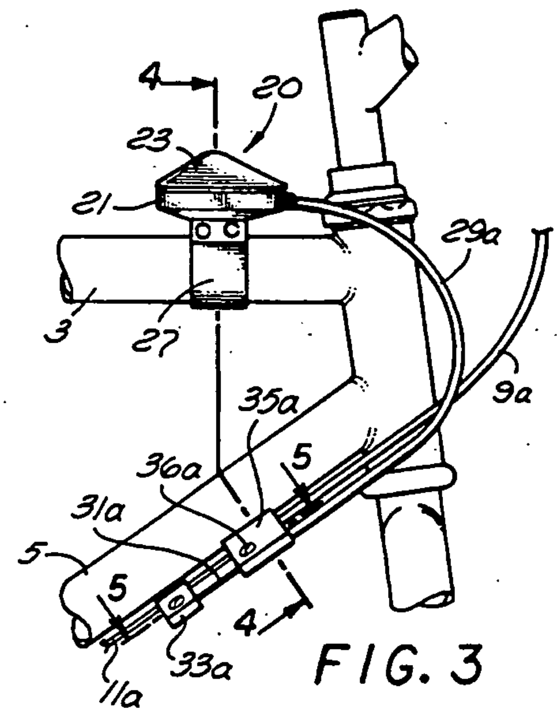


FIG. 3

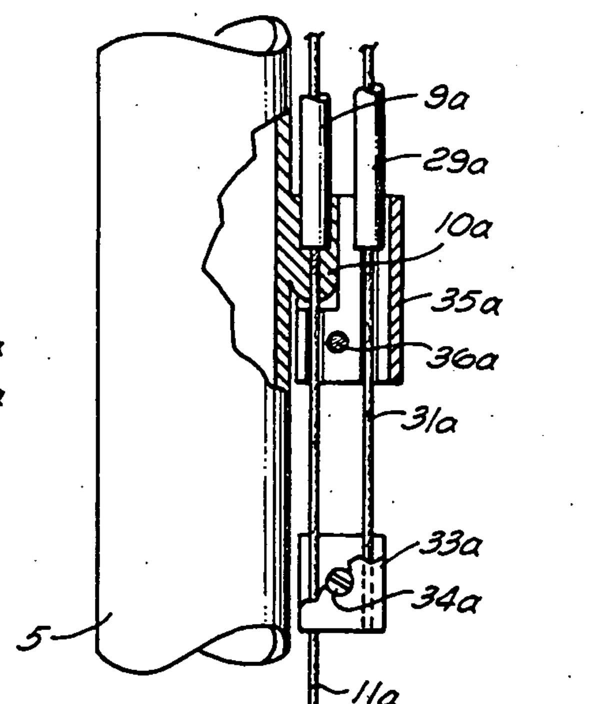


FIG. 5

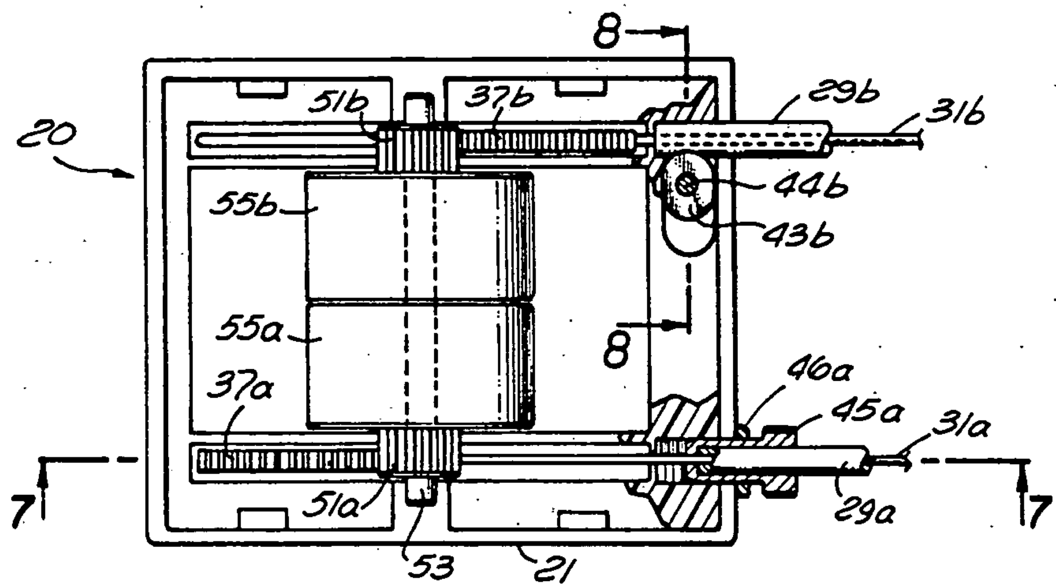


FIG. 6

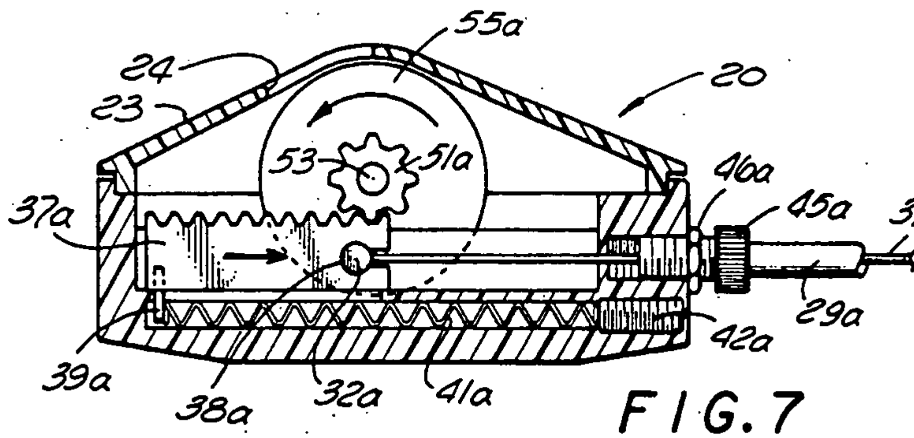


FIG. 7

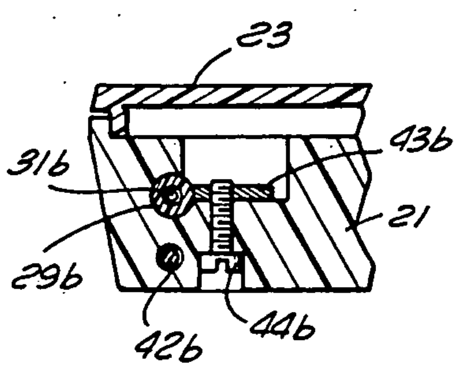


FIG. 8

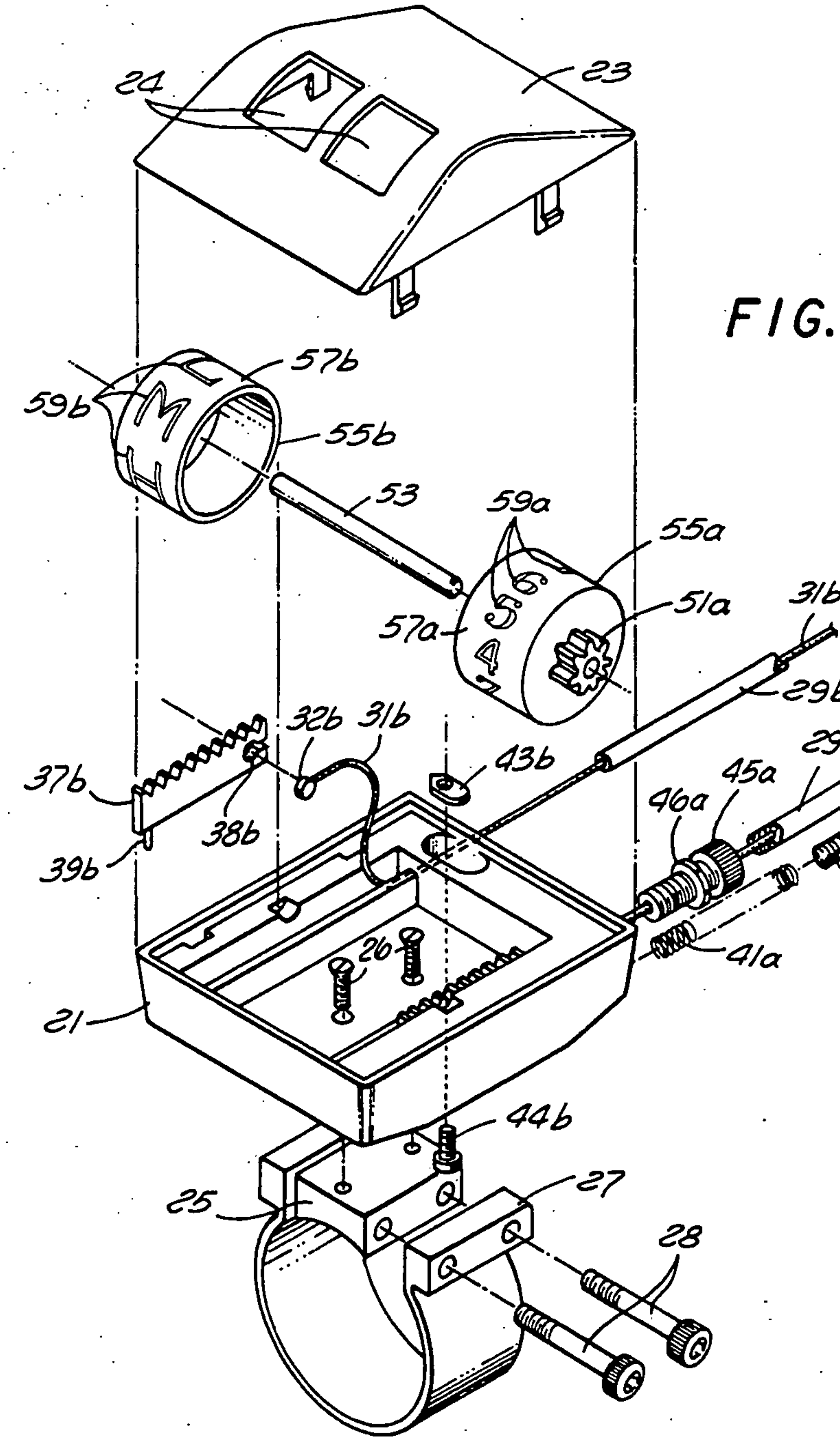

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FIG. 9

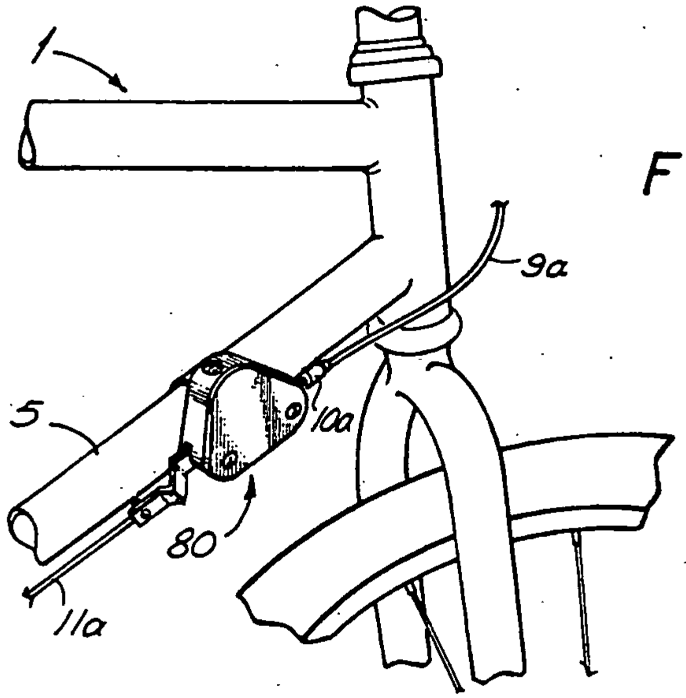
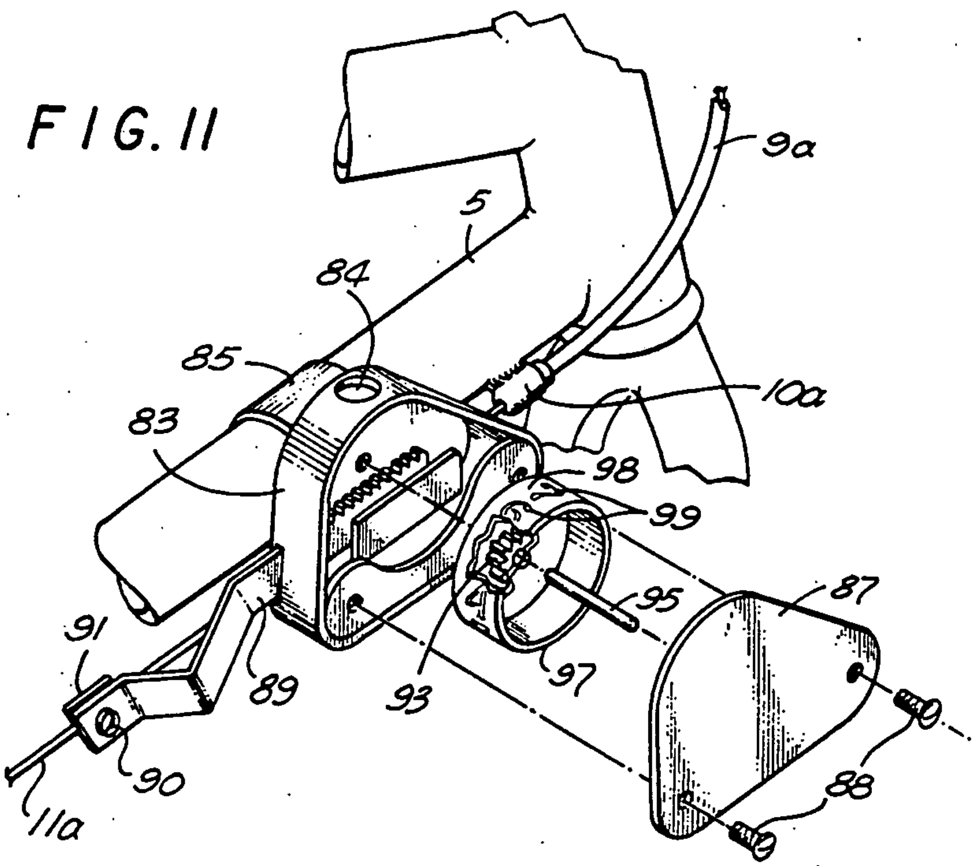


FIG. 10

FIG. 11



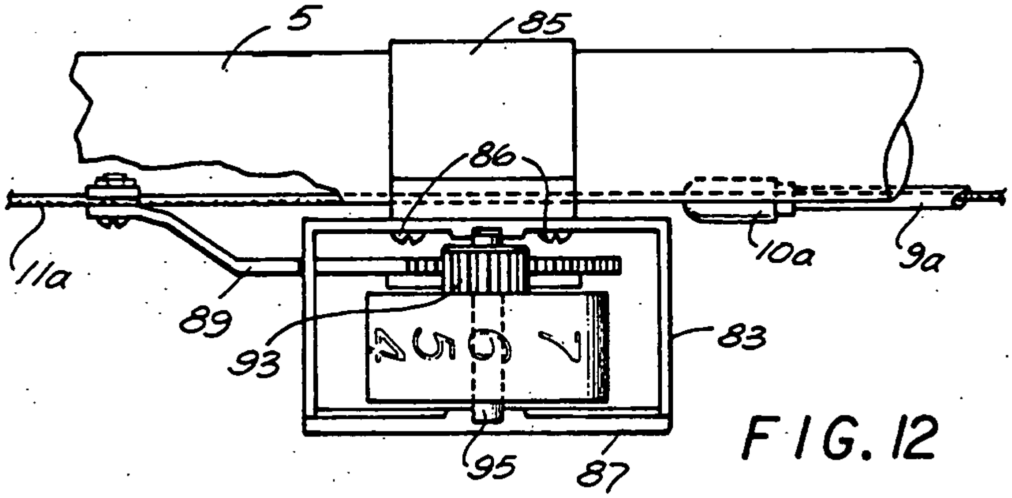


FIG. 12

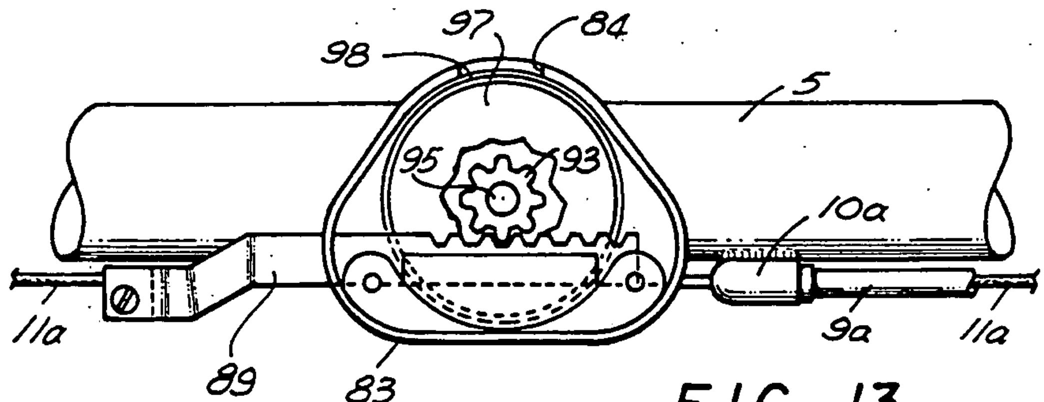


FIG. 13

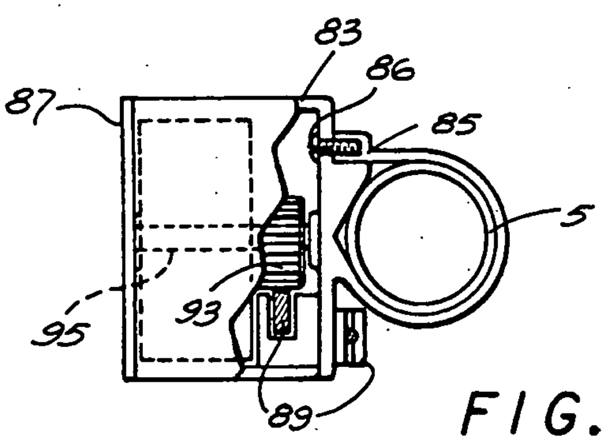


FIG. 14

BICYCLE GEAR DISPLAY

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention is a display device, for use on a multi-speed (multi-gear) bicycle, which displays the currently selected bicycle gear.

2. Art Background

The derailleur equipped bicycle is by far the most common type of multi-speed bicycle available today. These comprise between 5 and 8 sprockets (also known as cogs, a cluster, or more generally as gears) mounted on a freehub at the rear wheel of the bicycle and between 1 and 3 chainrings attached to the bicycle crank. By varying the combinations of front chainring and rear sprocket that are connected by the bicycle chain, a wide range of gear ratios may be obtained. This is accomplished by the use of front and rear derailleurs respectively. A problem inherent in this system is the difficulty involved in determining what gear the bicycle is in at a given moment. To do this, the rider must observe the chainrings and sprockets. Positioned between the rider's legs, the front chainrings are fairly easy to see and, with the relatively small number of chainrings, it is often possible to remember which chainring the chain is engaging. The rear sprockets are by contrast rather difficult to see from a riding position. In trying to view the sprockets, a rider must take his eyes off the road and engage in a series of contortions while also interrupting his pedaling cadence. The dangers and inconveniences of this are readily apparent.

To solve this problem, a gear indicator is required which is located in a position that is easily viewable. In the prior art, a number of solutions have been proposed. These have generally involved either using a shift lever itself as the indicator, or connecting an indicator thereto. The first case is illustrated in U.S. Pat. No. 4,924,723 to Cristie. Cristie relates to a very simple stem mounted stick shifter. A lever is mounted substantially vertically and rotates about a horizontal shaft. The shift cable is mounted to a shorter arm of the lever which extends downward from the shaft. A longer upward extending arm is manually rotated to change gears. The arm protrudes through a slot in a housing. Numerals are inscribed on the housing along the slot. The numerals are positioned to line up with the arm when the bicycle is in the corresponding gear.

Examples of the second situation can be seen in U.S. Pat. Nos. 3,524,979 to Cohen and 4,586,396 to Nagano. As does Cristie, Cohen relates to a stick-type shifter. The stick is mounted on a horizontal shaft onto which a pulley is also mounted. The shift cable end is fixed relative to the pulley so that rotation of the shift will wrap or unwrap the cable from the pulley. The pulley is integrated with a driving gear which meshes with a smaller driven gear which in turn drives a rotary display via a flexible shaft (a spring bent 90 degrees).

Nagano relates to an improved arrangement for downtube mounted shift levers. Although shift levers have generally been disposed on opposite sides of the downtube, for ergonomic considerations Nagano places them atop the downtube and thus adjacent to one another. The patent's drawings further disclose a display member which is used to indicate which rear sprocket the chain engages. Although not a subject of the claims, nor described in detail in the specification, the display member appears to take the form of numerals inscribed on a ring disposed between two shift levers, along their axis of rotation. Adjacently attached to the rear derailleur lever is a gear of radius slightly larger than the ring. The outer circumference of the ring is toothed. Meshing with the ring teeth and lever gear is a small gear having two sections, one section necessarily of lesser radius than the other. By this mechanism, the rotation of the ring is amplified relative to that of the lever.

An electronic gear display is provided in U.S. Pat. No. 4,859,984 to Romano. Romano discloses the use of sensors attached to shift levers to determine the engaged gear. The sensors are connected to an electronic display. The sensors use a series of switch contacts disposed on the levers so that the contacts are selectively connected according to lever position.

All known prior art references for gear indicator devices require integration of the device with the shift lever (or knob, etc.) mechanism. All such devices require that either the indicator itself or gear position sensor be integrated with the shift lever. Due to the required integration, these devices are not suitable for aftermarket installation. Furthermore, as the shift levers on modern bicycles are located in a variety of places (downtube, handlebar, stem and handlebar-end mounted configurations predominating), the devices that require integration do not have the abilities to adapt to the various configuration. Finally, with the introduction of ratcheting or so called push-button shifters which are now prevalent on mountain bicycles (MTBs) use of the lever itself as an indicator is no longer feasible, as its position is unrelated to the engaged gear.

SUMMARY OF THE INVENTION

To solve the above-mentioned problems, the present invention provides a separate display which indicates which of the sprockets is engaged by the chain. Although, as noted above, the shift levers on modern bicycles are located in a variety of places, a common attribute shared by most systems is that the bare shifter cables pass along the bicycle downtube, the sloping tube between the front fork area (head tube) and the crank area (bottom bracket). In the present invention, it is the motion of the cable that is detected to provide the display information. Accordingly the movement of the cable which controls the derailleur simultaneously controls the display. A toothed rack and a meshing pinion gear can be used to convert the linear cable motion into rotational motion of a display.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of a bicycle bearing the dual-display, remote embodiment of the present invention.

FIG. 2 is a perspective view of the front end of a bicycle bearing the dual-display, remote embodiment of the present invention.

FIG. 3 is a side view of the dual-display, remote embodiment of the present invention as mounted on a bicycle top tube.

FIG. 4 is a cutaway view of the dual-display, remote embodiment of the present invention as viewed along the axes of the bicycle top tube and downtube.

FIG. 5 is a cutaway view of the downtube, showing the shift cable interfacing in the remote embodiment.

FIG. 6 is a top view of the remote embodiment of the present invention with the cover removed.

FIG. 7 is a side cutaway view of the dual-display, remote embodiment of the present invention.

FIG. 8 is a front cutaway view of the dual-display, remote embodiment of the present invention.

FIG. 9 is an exploded view of the dual-display, remote embodiment of the present invention.

FIG. 10 is a perspective view of the downtube mounted embodiment of the present invention as mounted on a bicycle.

FIG. 11 is a partially exploded view of the downtube mounted embodiment of the present invention as mounted on a bicycle.

FIG. 12 is a side cutaway view of the downtube mounted embodiment of the present invention including a section of the downtube.

FIG. 13 is a top cutaway view of the downtube mounted embodiment of the present invention showing the connection with a bicycle shift cable.

FIG. 14 is a cutaway view of the downtube mounted embodiment of the present invention as viewed along the downtube axis.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

An embodiment of the display device 20 for remote mounting also featuring displays for both front and rear derailleurs is depicted in FIGS. 1 through 9. Shifter cables 11*a* and 11*b* for controlling rear and front derailleurs 13 and 15 of bicycle 1 respectively, run adjacent to downtube 5. Slave cables 31*a* and *b* are respectively attached to the shift cables and are used to translate the motion of the shift cables to the remote location where the display is mounted. The slave cables are connected to actuator racks 37*a* and *b* respectively. The actuator racks drive pinion gears 51*a* and *b* which rotate the display members 55*a* and *b*.

The first ends of slave cables 31*a* and *b* are respectively attached to the shift cables 11*a* and *b* by clamps 33*a* and *b* with screws 34*a* and *b*. The first ends of slave cable casings 29*a* and *b* are held relative to the downtube using casing clamps 35*a* and *b* and screws 36*a* and *b* to clamp the casing ends to the shift cable bosses 10*a* and *b* respectively. The other ends of the casings are routed to the display housing 21. The casings may be attached to the display housing by a clamp such as 43*b* with screw 44*b*. Among other alternatives, the casing may be connected to the housing by an adjustment collar such as 45*a* with collar locking nut 46*a*. It will be understood that although FIG. 6 illustrates two alternative means for attaching the cable casings to the display housing, both of casings 29*a* and *b* may be secured in the same way.

The second ends of the slave cables are fitted with beads 32*a* and *b* to connect with slots 38*a* and *b* in actuator racks 37*a* and *b* respectively. Alternatively, racks 37*a* and *b* may be molded from a suitable plastic material such that the slave cables are formed integrally therewith. The racks are slidably fit in the display housing. Slave cable biasing springs 41*a* and *b* held with set screws 42*a* and *b* exert pressure between tabs 39*a* and *b*, on the racks 37*a* and *b* respectively, and the housing to keep the slave cables 31*a* and *b* in tension.

Positioned in mesh with the racks, 37*a* and *b* respectively, are pinion gears 51*a* and *b* riding on a shaft 53. Indicator members 55*a* and *b* are connected to the pinion gears 51*a* and *b* respectively. The indicator members have cylindrical faces 57*a* and *b* with gear markings 59*a* and *b* respectively. A cover 23 with display windows 24*a* and *b* fits atop the housing such that the markings may be seen through the windows. A clamping block 25 is attached to the bottom of the housing by screws 26. A tube clamp 27 and screws 28 attach the block to the bicycle top tube 3 to thus mount the housing. Although block 25 and clamp 27 are shown as separate pieces, these may be formed as a single integral molding.

When the shift levers 7*a* and *b* are used to adjust the rear and front derailleurs via the shift cables 11*a* and *b*, the longitudinal motion of the shift cables is transmitted to the slave cables 31*a* and *b* respectively. The slave cables in turn move the racks 37*a* and *b* which causes the pinions to rotate so as to bring the display markings corresponding to the currently selected rear an gears into view. As shown in FIG. 9 the indicator members 55*a* and *b* are marked "7-6-5-4-3-2-1" (59*a*) and "L-M-H" (59*b*) which were chosen for a bicycle with seven rear cogs and three front chainrings. Alternative markings may be employed such as, for example, different colors to indicate the different gears. This is particularly applicable to the chainring indicator since this tends to be less precise. Proper alignment of the markings may be achieved by adjusting the position of the clamps 33*a* and *b* along the shift cables. If adjustment collars such as 45*a* are provided, they may also be used for this purpose.

Although the remote mounting embodiment is shown mounted on the top tube, it is obvious that it may also be mounted elsewhere on the bicycle frame, including on the handlebar 4 or stem 8 if desired.

An embodiment of the display device 80 for downtube mounting is depicted in FIGS. 10 through 14. Its function is similar to the remote embodiment, except the slave cables and related hardware are eliminated,in favor of attaching the rack directly to the shift cable.

As is generally the case with derailleur equipped bicycles, a section of bare shift cable 11*a* runs adjacent to the bicycle downtube 5. An actuator rack 89 is attached to the cable by a clamp 91 and screw 90. The rack is oriented so as to slide within a display housing 83 which is attached to the downtube by integral tube clamp 85 and screws 86. Positioned in mesh with the rack is a pinion gear 93 riding on a shaft 95. An indicator member 97 is connected to the pinion. The indicator member has a cylindrical face 98 with gear markings 99 which are visible through a window 84 in the housing. A cover 87 is attached to the housing with screws 88. When the shift cable is moved, the rack causes the pinion to rotate so as to bring the marking corresponding to the current gear into view. As shown in FIG. 12, the display has markings "7-6-5-4-3-2-1" which were chosen for use on a bicycle with 7 rear cogs. Proper alignment of the markings may be achieved by adjusting the position of the rack along the shift cable.

The above embodiments are merely illustrative of displaying the selected gear(s) based upon the position of the shift cable(s). In addition to permutations such as a single display remote or dual display downtube models, the mechanism may be modified to replace the use of racks and pinions. Furthermore, the mechanical indicator members of the described embodiments may be replaced with a suitable electronic display, such as a liquid crystal device, and associated electronic circuitry providing display outputs responsive to the cable position. Various position sensing devices are well known. Also, the device may be modified to show a gear ratio as opposed to numbers or letters intended to denote the specific cogs and chainrings. This would be especially appropriate if the device was made in an electronic

form, taking the input from the motion of the shift cables and displaying a number indicative of an overall gear ratio.

Although the above discussion is based on the common derailleur bicycle with standard frame configuration, it would be obvious to one of ordinary skill in the art that the present invention may be used wherever a similar physical situation is encountered. For instance, on a bicycle featuring a transmission housed in the rear hub, such as STURMEY ARCHER, which is still cable operated, the present invention would be quite useful. Additionally, on cycles of yet unknown configurations, the present invention may be used wherever there is a gear changing cable to access. Finally, non-gear and non-bicycle applications are possible if an analogous physical situation is present.

I claim:

1. A gear display accessory device for attachment to a multi-gear bicycle, said bicycle having cable-operated gear shifting means with a gear shift cable extending between a shift lever and a gear shifting mechanism, comprising:

means for interfacing with the gear shift cable comprising clamping means said means for interfacing for clamping to an exposed portion of the gear shift cable between the shift lever and the gear shifting mechanism;

display means for indicating a currently selected gear;

means for coupling the display means to the cable interfacing means; and

a housing.

2. The gear display device of claim 1, wherein

a) the cable interfacing means includes a toothed rack attached to the gear shift cable and oriented substantially parallel thereto, and,

b) the coupling means includes a pinion gear positioned in mesh with the rack and coupled to the housing for axial rotation, such that longitudinal motion of the gear shifting cable rotates the pinion.

3. The gear display device of claim 2, wherein said display means has an indicator member with indicia disposed thereon corresponding to respective gears.

4. The gear display device of claim 3, wherein the indicator member is substantially cylindrical and is coaxially attached to the pinion.

5. The gear display device of claim 1, wherein said bicycle includes a second cable-operated gear changing means and a second gear shift cable further including:

second means for interfacing with the second gear shift cable;

second display means for indicating a gear currently selected by the second gear changing means; and,

means for coupling the second display means to the second interfacing means.

6. The gear display device of claim 1, wherein the cable interfacing means includes a slave cable having first and second ends, the first end being coupled to the gear shifting cable.

7. The gear display device of claim 6 wherein

a) the cable interfacing means further includes a toothed rack coupled to the second end of the slave cable,

b) the means for coupling the display and cable interface means includes a pinion gear positioned in mesh with the rack and coupled to the housing for axial rotation, such that longitudinal motion of the gear shifting cable rotates the pinion, and,

c) the coupling means further includes a shaft carried by the housing, on which shaft the pinion rides.

8. The gear display device of claim 7 wherein the cable interface means further includes a slave cable casing enclosing a segment of the slave cable.

9. The gear display device of claim 8 wherein the slave cable casing has a first end coupled to the frame of the bicycle and a second end coupled to the housing.

10. The gear display device of claim 9, wherein said display means has an indicator member with indicia disposed thereon corresponding to a respective gears.

11. The gear display device of claim 10, wherein the indicator member is substantially cylindrical and is coaxially attached to the pinion.

12. A gear display device for a multi-gear bicycle, said bicycle having a frame and having first and second cable-operated gear shifting means with first and second gear shift cables routed along the frame, comprising:

a housing including a clamp for mounting on the bicycle and a cover with at least one window;

means for interfacing with the first and second gear shift cables including:

first and second slave cables each having first and second ends, the first end of each cable being clamped to the respective first and second gear shift cables;

first and second slave cable casings enclosing segments of the respective slave cables and having one end coupled to the bicycle frame and another end coupled to the housing;

first and second toothed racks coupled to the second ends of the respective slave cables;

display means for indicating respective gears currently selected by said first and second gear shifting means, including first and second indicator members, which indicator members include indicia corresponding to the respective gears of the first and second gear changing means; and

means for coupling the display means to the cable interfacing means including first and second pinion gears coupled to the respective indicator members and positioned in mesh with the first and second racks respectively and coupled to the housing for axial rotation, such that longitudinal motion of the first and second gear shift cables rotates the respective pinion.

13. The gear display device of claim 3, wherein the housing has an aperture therethrough for exposing the indicator member.

14. The gear display device of claim 1 wherein the display means comprises an electronic display.

15. A gear display device for a multi-gear bicycle, said bicycle having cable-operated gear shifting means with a gear shift cable, comprising:

a housing;

means for interfacing with the gear shift cable, including a toothed rack attached to the gear shift cable and oriented substantially parallel thereto;

display means for indicating a currently selected gear, including a pinion gear positioned in mesh with the rack and coupled to the housing for axial rotation, such that longitudinal motion of the gear shifting cable rotates the pinion; and

means for coupling the display means to the cable interfacing means, including an indicator member with indicia disposed thereon corresponding to respective gears wherein the indicator member is

substantially cylindrical and is coaxially attached to the pinion.

16. The gear display device of claim 15 wherein the housing has an aperture therethrough for exposing the indicator member.

17. The gear display device of claim 15 wherein the display means comprises an electronic display.

18. A gear display device for a multi-gear bicycle, said bicycle having first and second cable-operated gear shifting means with respective first and second gear shift cables, comprising:

a housing;

first means for interfacing with the first gear shift cable;

first display means for indicating a gear currently selected by the first gear shifting means;

means for coupling the first display means to the first cable interfacing means;

second means for interfacing with the second gear shift cable;

second display means for indicating a gear currently selected by the second gear shifting means; and

means for coupling the second display means to the second interfacing means.

19. The gear display device of claim 18 wherein the housing has a pair of apertures therethrough for exposing the first and second display means.

20. The gear display device of claim 18 wherein at least one of the first and second display means comprises an electronic display.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 5,178,033

DATED : January 12, 1993

INVENTOR(S) : August Kund

It is certified that error appears in the above-indentified patent and that said Letters Patent is hereby corrected as shown below:

Col. 5, line 24, after "means" delete "said means for interfacing" and insert after "clamping"

Col. 6, line 11, after "to" delete "a"

Signed and Sealed this

Twenty-second Day of March, 1994

Attest:

BRUCE LEHMAN

Attesting Officer *Commissioner of Patents and Trademarks*

United States Patent [19]

Bass

[11] **Patent Number: 4,635,442**

[45] **Date of Patent: Jan. 13, 1987**

[54] **HYDRAULIC MASTER CYLINDER ASSEMBLY**

[75] Inventor: **Richard A. Bass, Leamington Spa, England**

[73] Assignee: **Automotive Products plc, Leamington Spa, England**

[21] Appl. No.: **766,269**

[22] Filed: **Aug. 16, 1985**

[30] **Foreign Application Priority Data**

Aug. 29, 1984 [GB] United Kingdom 8421830

[51] **Int. Cl.**[4] **B60T 7/02**

[52] **U.S. Cl.** **60/594**; 188/344; 60/584

[58] **Field of Search** 60/594, 584; 74/522, 74/525; 188/344, 24.15

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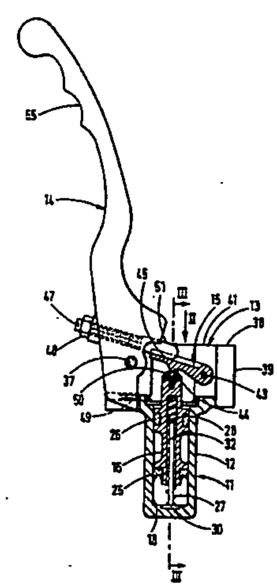
Primary Examiner—Carroll B. Dority, Jr.

Attorney, Agent, or Firm—Solon B. Kemon

[57] **ABSTRACT**

This invention relates to hydraulic master cylinder assemblies having a hydraulic master cylinder and an actuating mechanism and in particular to a hydraulic master cylinder assembly in which it is possible to alter the travel ratio between a driver operable actuating lever and a piston of the hydraulic master cylinder. The actuating mechanism includes a lever mechanism interposed between the actuating lever and the piston the effective lever arm length of which can be altered by means of an adjustable member forming part of the lever mechanism.

21 Claims, 8 Drawing Figures



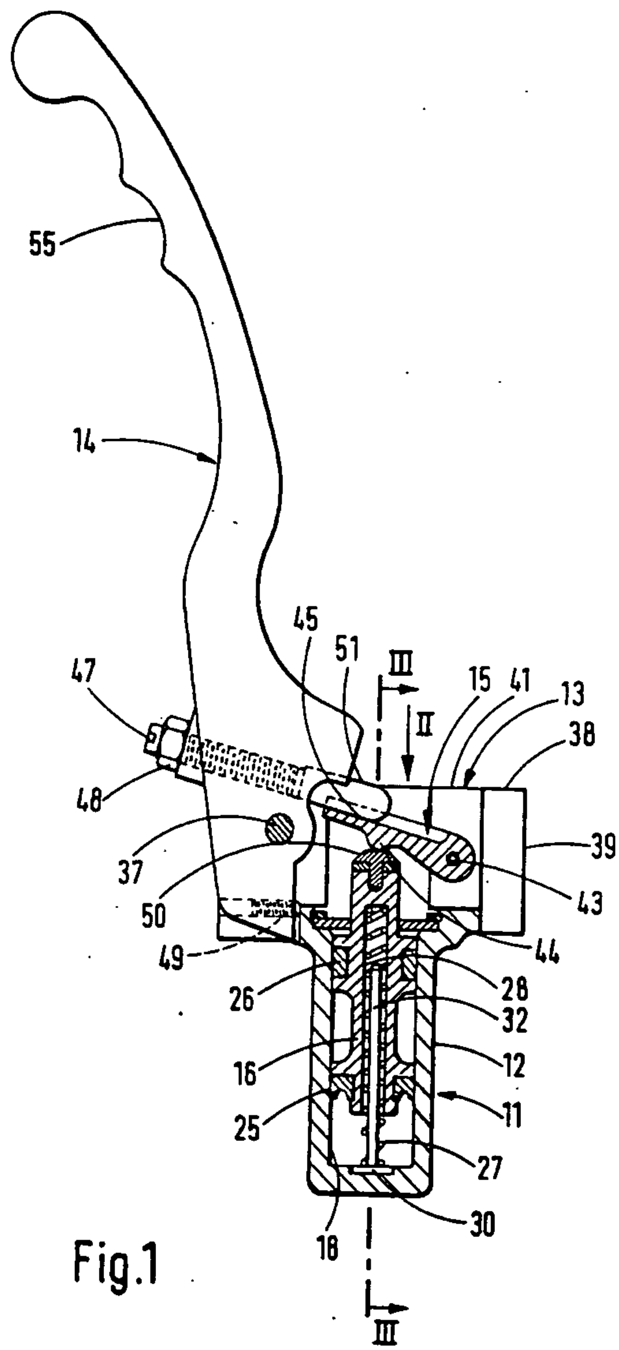

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Fig.1

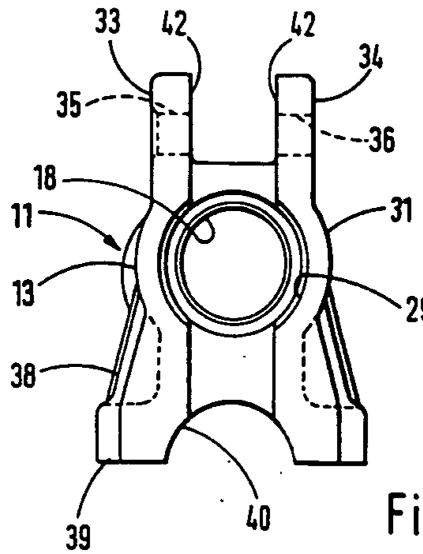
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Fig.2

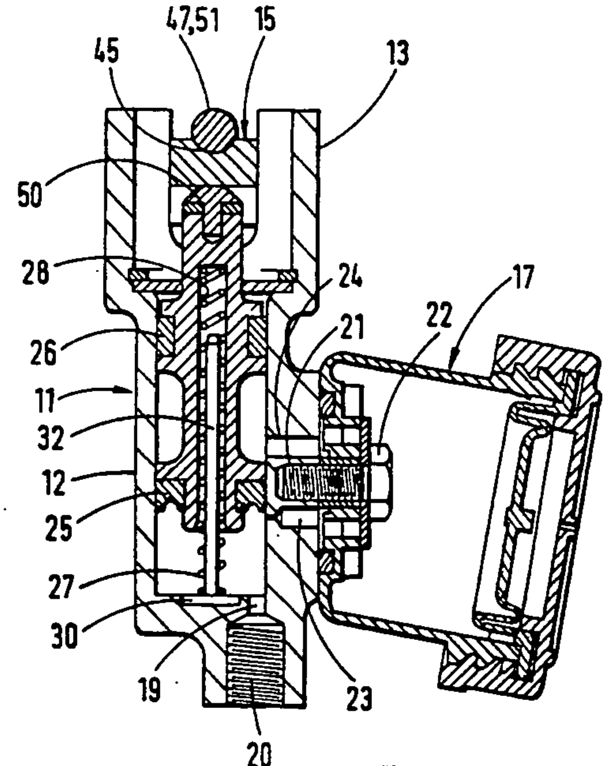
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Fig.3

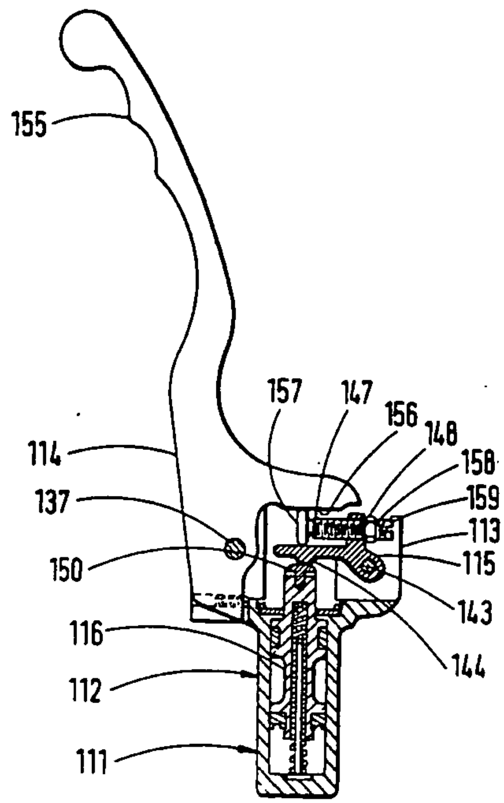
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Fig.5

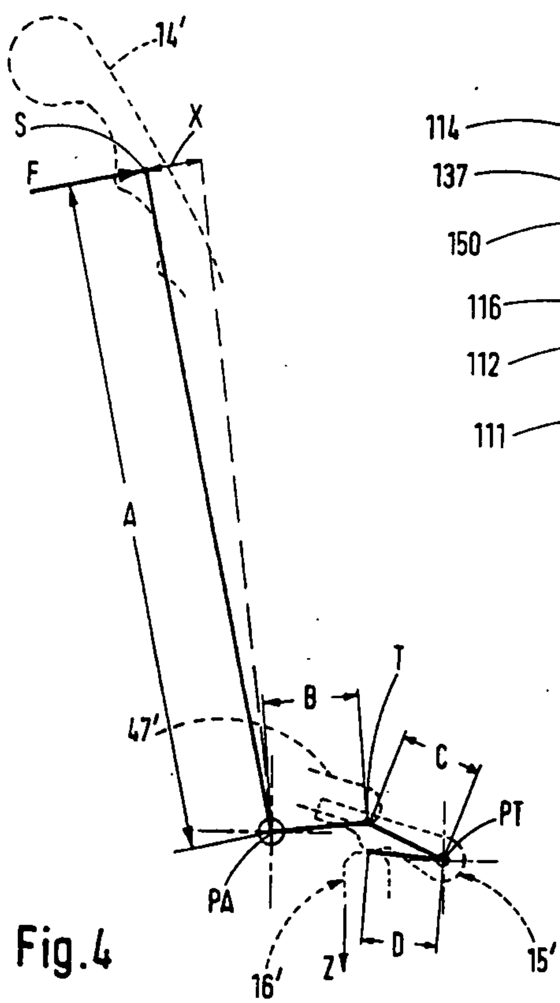
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Fig.4

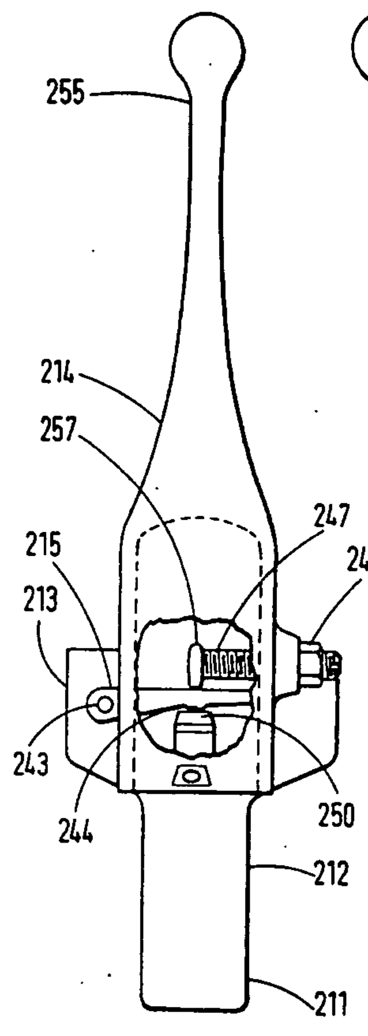
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Fig.7

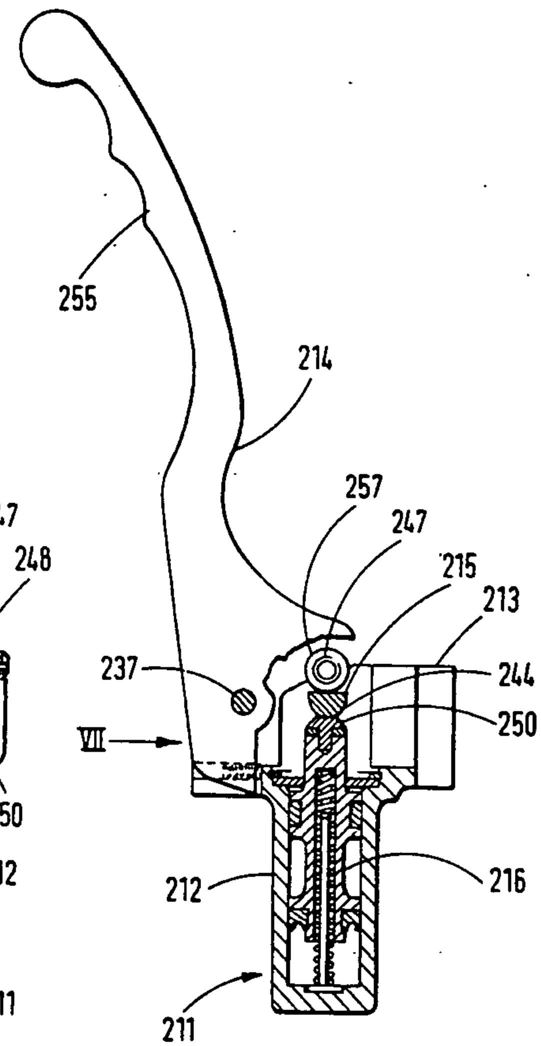
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Fig.6

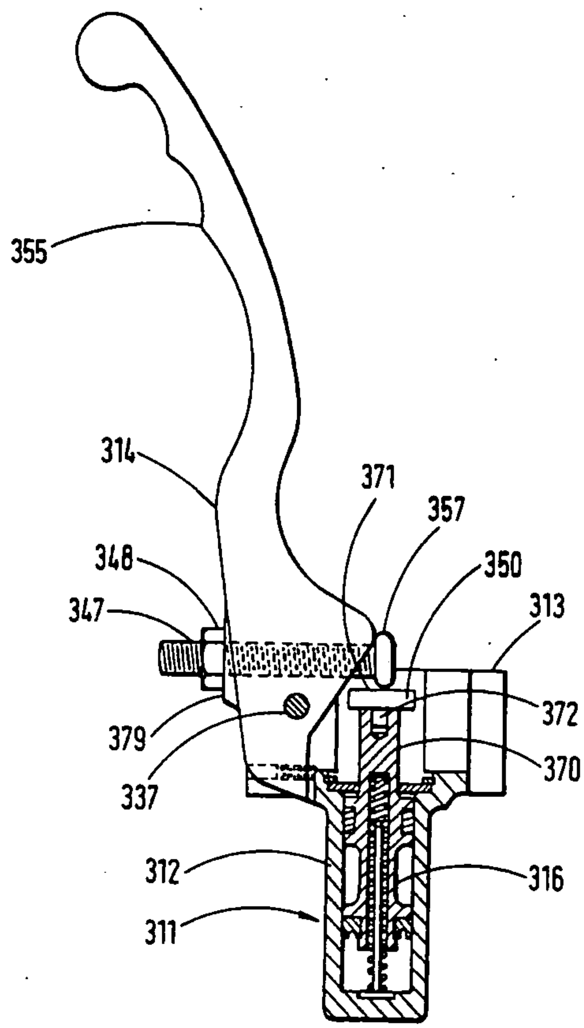

Fig.8

HYDRAULIC MASTER CYLINDER ASSEMBLY

This invention relates to hydraulic master cylinder assemblies and particularly but not exclusively to brake master cylinder assemblies for motorcycles.

It is known to provide a hydraulic master cylinder comprising a hydraulic master cylinder and an actuating mechanism, the hydraulic master cylinder having a piston slidable in a bore in the body of the master cylinder, the actuator level operatively connected to the piston to effect axial movement thereof in response to driver operation of the actuating lever.

The large range of applications for hydraulic master cylinders requires the manufacturer to offer a range of master cylinders of differing bore diameters to accommodate variations in hydraulic system capacity. It is not economically viable to offer a different bore diameter to suit each specific application instead a range of master cylinders is offered in standard sizes. The fact that the ideal bore diameter is not available is not normally a serious drawback and a suitable compromise can often be found. If however, the master cylinder is to be used for a motorcycle braking system it is important that the bore diameter is as close as possible to the ideal size in order to obtain the highest possible efficiency.

In the case of racing motorcycles it is important that the correct diameter master cylinder is used for each application. A motorcycle racing team may well have a range of master cylinders of differing bore diameters for each motorcycle to suit different circuits and weather conditions and variations in rider technique.

It is an object of the invention to provide a master cylinder that can be adjusted to suit a particular installation.

According to the invention there is provided a hydraulic master cylinder assembly comprising a hydraulic master cylinder and an actuating mechanism, the hydraulic master cylinder having a body member defining a bore therein, and being adapted for attachment to part of a vehicle a piston slideably supported in the bore and having an input member for co-operation with part of the actuating mechanism, the actuating mechanism having a driver operated actuating lever and an operative connection to connect the actuating lever to the input member said operative connection including means for altering the travel ratio between the actuating lever and the input member.

Conveniently said operative connection may include a lever mechanism and the means for altering the travel ratio include an adjustable abutment.

Preferably, the lever mechanism includes a transfer lever interposed between the adjustable abutment member and the input member.

Alternatively, the lever mechanism may be formed by the adjustable abutment member and the adjustable member will react directly against the input member.

The invention will now be described by example with reference to the accompanying drawings, in which:

FIG. 1 is a cross section through a first embodiment of a master cylinder assembly according to the invention;

FIG. 2 is an end view in the direction of arrow II in FIG. 1 showing a body member of the master cylinder assembly in FIG. 1;

FIG. 3 is a cross-section on the line III—III of the master cylinder assembly of FIG. 1

FIG. 4 is a skeletal view similar to FIG. 1 showing the geometrical relationship between the various functional components of the masters assembly shown in FIG. 1;

FIG. 5 is a cross-sectional view similar to that of FIG. 1 but showing a second embodiment of a master cylinder assembly according to the invention;

FIG. 6 is a cross-sectional view similar to that of FIG. 1 but showing a third embodiment of a master cylinder assembly according to the invention;

FIG. 7 is a cut-away view in the direction of arrow VII in FIG. 6;

FIG. 8 is a cross-sectional view similar to that of FIG. 1 but showing a fourth embodiment of a master cylinder assembly according to the invention;

The master cylinder assembly of FIGS. 1 to 4 comprises a hydraulic master cylinder 11 and an actuating mechanism. The hydraulic master cylinder 11 has a body member 12 slideably supporting a piston 16 therein and is adapted by means of a slotted end portion 13 for attaching the master cylinder assembly upon the handlebar (not shown) of a motor cycle. An actuating lever 14 and a transfer lever 15 are pivoted upon the end portion 13 to connect the actuating lever 14 to the piston 16.

The body member 12 defines a bore 18 having an outlet 19 at one end of the bore 18 to which a pipe or hose maybe connected by the screw-threaded aperture 20. A blind screw-threaded bore 21 is provided to co-operate with a bolt 22 securing the reservoir 17 to the body 11. Bypass and reservoir ports 23, 24 are provided to connect the bore 18 to the reservoir 17.

The piston 16 has main and secondary cup seals 25, 26 and a blind bore in one end in which a compression spring 27 is housed to bias the piston 16 away from the outlet 19 and an input member in the form of a wear resistant pad 50 at the other end. A guide pin 32 coaxial with the bore 28 and extending axially through the spring 27 is connected to the body 11 by a plate 30.

The end portion 13 has a part-cylindrical central portion 31 the bore 29 of which is concentric with the bore 18 in the master cylinder portion 12, two parallel flanges 33, 34 each having a through hole 35, 36 in which a pivot pin 37 is secured, and a webbed base portion 38 having a bottom face 39 in which a part-cylindrical slot 40 is formed to cooperate with the handlebar. The end face 41 of the end portion 13 has a slot 42 formed in it into which the transfer lever 15 is located.

The actuating lever 14 is pivotally connected by the pivot pin 37 to the end portion 13 and has a portion away from the pivotal connection that is contoured to provide a comfortable hand grip 55. A rod in the form of a set screw 47 is in threaded engagement with the actuating lever 14. The set screw 47 forms a movable abutment member and is locked into position by a lock-nut 48. A grub screw 49 is provided to adjust the resting position of the actuating lever 14.

The transfer lever 15 is pivotally supported by a pivot pin 43 secured in the base portion 38 and has a pivot axis arranged to be substantially parallel to the pivot axis of the actuating lever 14. The transfer lever 15 has a convex abutment surface in the form of a lobe 44 for reaction against the pad 50 and a concave abutment surface in the form of the longitudinal groove 45 to co-operate with a part-spherical end portion 51 of the set screw 47.

To operate the master cylinder assembly a driver or rider applies a force to the actuating lever 14 causing it

to rotate about the pivot pin 37. The rotation of the actuating lever 14 causes the set screw 47 to react against the transfer lever 15 which rotates about the pivot pin 43.

The lobe 44 transfers the load applied to the transfer lever 15 to the pad so thereby displacing the piston 16 to increase the hydraulic pressure in the hydraulic master cylinder 11.

The travel ratio for the master cylinder assembly is the ratio of the linear movement of the piston 16 obtained for a specified linear displacement of a known point on the actuating lever 14. The known point is the effective position where the applied force acts. The travel ratio of the master cylinder assembly is adjustable by rotating the set screw 47 which will move axially thereby altering its position of contact with the transfer lever 15. If for example, the set screw 43 contacts the transfer lever 15 near to the pivot pine 43 then the travel ratio will be high as a small actuating lever 14 movement will produce a relatively large axial displacement of the piston 16. With reference to FIG. 4 there is shown in skeletal form the master cylinder assembly of FIGS. 1–3 showing in ghosted outline the transfer lever 15' the piston 16' and the actuating lever 14'.

If a force F is applied to the actuating lever 14' by the rider at a distance A from the pivot axis PA (corresponding to point (s) on FIG. 4) causing the point (s) to be angularly displaced equivalent to a linear distance X then it can be shown that the linear displacement Z of the piston 16' is equal to

$$Z = X \times (D/C) \times (B/A) \quad \text{(i)}$$

The displacement ration Z/X is therefore equal to

$$(D/C) \times (B/A) \quad \text{(ii)}$$

From equation (ii) it can therefore be seen that if the length B is increased the displacement ratio is also increased and if the length B is reduced the displacement ratio is reduced. From FIG. 4 is can also be seen that reducing the length B increases the length C and vice versa. Therefore, increasing the length B not only increases the travel ratio due to its increase in length but also due to the reduction in the length C.

Therefore, it can be seen that by moving the position of abutment(T) of the set screw 47' against the transfer lever 15' the travel ratio can be altered.

The master cylinder assembly of FIG. 5 comprises a hydraulic master cylinder 111 and an actuating mechanism. The hydraulic master cylinder 111 has a body member 112 slideably supporting a piston 116 therein and is adapted by means of an end portion 113 for attaching the master cylinder assembly to part of a vehicle (not shown). The actuating mechanism includes an actuating lever 14. a transfer lever 115 and a set screw 147. The end portion 113 pivotally supports the actuating lever 114 and the transfer lever 115 by means of two press fitted pivot pins 137 and 143 the pivot axes of which are substantially parallel to one another. The actuating lever 114 has a portion away from the pivot pin 137 that is contoured to provide a hand grip 155 and a flat abutment surface 156 for abutment with an adjustable abutment member interposed between the actuating lever 114 and the transfer lever 115. The set screw 147 and the transfer lever 115 form a lever mechanism between the actuating lever 119 and the piston 116.

The adjustable abutment member is in the form of the set screw 147 threadably engaged with the transfer lever 115 and lockable into position by a locknut 148. The set screw has a disc shaped head 157, the outer peripheral surface of which is convex, and a screw-threaded shank 158. The end of the screw-threaded shank 158 away from the head 157 has a slot 159 in it into which a suitable tool can be fitted to rotate the set screw 147.

The transfer lever 115 has a convex abutment surface in the form of the lobe 144 for cooperation with an input member of the master cylinder 112. The input member is in the form of a wear resistent pad 150 attached to an extension of the piston 116. Operation of the master cylinder assembly is substantially as described with reference to FIGS. 1 to 4 and the travel ratio can be similarly altered by moving the set screw 147. Any axial movement of the set screw 147 will have a two-fold effect on the travel ratio. For example, if the distance between the position of contact of the set screw 147 against the actuating lever 114 and the pivot axis of the actuating lever 114 is increased this will reduce the distance between the position of contact of the set screw 147 against the actuating lever 114 and the pivot axis of the transfer lever 115.

The master cylinder assembly shown in FIGS. 6 and 7 is similar in many respects to that shown in FIGS. 1 to 4 and part similar to those described with respect to FIGS. 1 to 4 have the same reference numerals with the addition of 200.

The master cylinder assembly comprises a hydraulic master cylinder 211 and an actuating mechanism. The hydraulic master cylinder 211 having a body member 212 and an end portion 213 for attaching the master cylinder assembly to part of a vehicle (not shown). The body member 212 defines a bore therein in which a piston 216 is slideably supported.

The actuating mechanism includes an actuating lever 214 a transfer lever 215 and a set screw 247. The end portion 213 pivotally supports the actuating lever 214 and the transfer lever 215 by means of two press-fitted pivot pins 237 and 243. The pivotal axis of the actuating lever 214 and the transfer lever 125 are perpendicularly arranged with respect to one another. The transfer lever 215 and the set screw 247 form a lever mechanism between the actuator lever 214 and the piston 216. The actuating lever 214 has a portion away from the pivot pin 237 that is contoured to provide a hand grip 255. The set screw 247 is in threaded engagement with the actuating lever 214 to provide an adjustable abutment member between the actuating and transfer levers 214 and 215. The set screw 247 is lockable in position by a lock nut 248 and has a disc shaped head 257 the outer peripheral surface of which is convex.

The transfer lever 215 has a convex abutment surface in the form of a lobe 244 for co-operation with an input member of the master cylinder and a flat surface for abutment with the head 257. The input member of the master cylinder is in the form of a wear resistant pad 250 attached to an extension of the piston 216.

To operate the master cylinder assembly a driver or rider applies a force to the actuating lever 214 at or near the hand grip 255 causing the actuating lever 214 to rotate about the pivot pin 237. The rotation of the actuating lever 214 is transmitted to the transfer lever 215 by the set screw 247 causing the transfer lever 215 to rotate about the pivot pin 243. The movement of the transfer lever 215 is transmitted to the piston 216 through the abutment of the lobe 244 with the pad 250.

To alter the travel ratio between the actuating lever 214 and the piston 216 the set screw 247 is rotated, thereby altering the distance between its position if abutment with the transfer lever 215 and the pivotal axis of the transfer lever 215. It should be appreciated that the longitudinal axis of the set screw is substantially parallel to the pivotal axis of the actuating lever 214 and so no variation in the distance between the pivotal axis of the actuating lever 214 and the position of abutment of the set screw 247 against the transfer lever 215 will occur when the set screw 247 is rotated to alter the travel ratio. Therefore, unlike the first and second embodiments previously described the change in travel ratio is due entirely to the variation in the distance of the position of abutment of the set screw 247 against the transfer lever 215 from the pivotal axis of the transfer lever 215.

In a fourth embodiment of the invention shown in FIG. 8 the master cylinder assembly is substantially the same as that described with reference to FIGS. 1 to 4 and parts similar to those described with respect to FIGS. 1 to 4 have the same reference numerals with the addition of 300.

The master cylinder assembly comprises a hydraulic master cylinder 311 and an actuating mechanism. The hydraulic master cylinder 311 has a body member 312 and an end portion 313 for attaching the master cylinder assembly to part of a vehicle (not shown).

The body member 312 pivotally supports a press-fitted pivot pin 337. The actuating mechanism includes the actuating lever 314 and a set screw 347. The actuating lever 314 has a screw threaded boss portion 379 and a portion away from its pivotal axis that is contoured to provide a hand grip 355. The set screw 347 is threaded into the boss portion 379 to provide both a lever mechanism and a movable abutment member between the actuating lever 314 and the piston 316. The set screw 347 is lockable in position by a lock nut 348 and has a disc shaped head 357, the outer peripheral of which is convex.

The head 357 of the set screw 347 abuts directly against a wear resistance pad 350 attached to an extension 370 of the piston 216. The pad 350 forms an input member of the master cylinder and has a flat face 371 for co-operation with the head 357 and a stem 372 used to attach the pad 350 to the extension 370.

To operate the master cylinder a force is applied to the actuating lever 314, as previously described, causing it to rotate about the pivot pin 337. The rotation of the actuating lever 314 moves the set screw 347 against the pad 350 thereby displacing the piston 316.

The travel ratio, that is to say the ratio of actuating lever 314 movement ot piston 316 movement can be seen to be equal to the ratio between the effective length of the actuating lever 314 and the distance of the position of abutment of the set screw 347 agains the pad 350 from the pivotal axis of the actuating lever 314. Therefore, by axially moving the set screw 347 the displacement ratio can be altered as the distance of the position of abutment of the set screw 347 against the pad 350 will be changed with respect to the pivotal axis of the actuating lever 314.

Although the invention has been described with reference to a hand operated brake master cylinder for a motorcycle it is envisaged that it could be a foot operated master cylinder or a clutch master cylinder operated by either foot or hand.

Similarly, although the moveable abutment has been described as a set screw attached to the actuating lever or transfer lever any device which allows the position of abutment of the actuating lever with the transfer lever or piston could be used.

It is an advantage of the invention that a large range of master cylinder capacities can be provided by a small number of different bore diameters. Such a facility is very advantageous from an economy of manufacture view point.

It is a further advantage of the invention that it is possible to obtain exactly the right master cylinder capacity with a small range of different bore diameters.

It is especially advantageous for use on racing motorcycles or cars that the travel ratio can be adjusted without removing the master cylinder assembly from the vehicle.

I claim:

1. A hydraulic master cylinder assembly comprising a hydraulic master cylinder and an actuating mechanism, the hydraulic master cylinder having a body member defining a bore therein and being adapted for attachment to part of a vehicle, a piston slideably supported in the bore, and an input member of the piston for co-operation with part of the actuating mechanism, the actuating mechanism having a driver operated actuating lever and an operative connection to connect the actuating lever to the input member said operative connection including means for altering the travel ratio between the actuating lever and the input member.

2. An assembly as claimed in claim 1 in which said operative connection further includes a lever mechanism and said means for altering the travel ratio includes an adjustable abutment.

3. An assembly as claimed in claim 2 in which said lever mechanism includes a transfer lever interposed between the adjustable abutment member and the input member.

4. An assembly as claimed in claim 3 in which the transfer lever is pivotally supported by the body member.

5. An assembly as claimed in claim 2 in which the actuating lever is pivotally supported by the body member.

6. An assembly as claimed in claim 4 in which the actuating lever is pivotally supported by the body member.

7. An assembly as claimed in claim 6 in which the pivot axis of the transfer lever is substantially parallel to the pivot axis of the actuating lever.

8. An assembly as claimed in claim 7 in which the adjustable abutment member is a rod supported by the actuating lever.

9. As assembly as claimed in claim 8 in which the rod is a set screw in threaded engagement with the actuating lever.

10. An assembly as claimed in claim 3 in which the transfer lever has convex abutment surface for co-operation with the input member.

11. An assembly as claimed in claim 7 in which the transfer lever has a convex abutment surface for co-operation with the input member.

12. An assembly as claimed in claim 8 in which the transfer lever has a convex abutment surface for abutment with the input member and a longitudinal groove to co-operate with the rod.

13. An assembly as claimed in claim 7 in which the adjustable abutment member is supported by the transfer lever.

14. An assembly as claimed in claim 13 in which the movable abutment member is a set-screw.

15. An assembly as claimed in claim 6 in which the pivot axis of the transfer lever is substantially perpendicular to the pivot axis of the actuating lever.

16. An assembly as claimed in claim 15 in which the adjustable abutment member is movable axially along an axis arranged substantially parallel to the pivot axis of the actuating lever.

17. An assembly as claimed in claim 16 in which the movable abutment member is a set-screw.

18. An assembly as claimed in claim 2 in which the movable abutment member is supported by the actuating lever.

19. An assembly as claimed in claim 18 in which the adjustable abutment member reacts directly against the input member and forms said lever mechanism.

20. An assembly as clamed in claim 19 in which the movable abutment member is a set-screw in threaded engagement with actuating lever.

21. An assembly as claimed in claim 20 in which the set screw has a part spherical end portion for abutment against the input member.

* * * * *

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United States Patent [19]

Gajek et al.

[11] Patent Number: 5,443,134

[45] Date of Patent: Aug. 22, 1995

[54] HYDRAULIC ACTUATING DEVICE FOR BRAKES AND GEARSHIFTS OF BICYCLES OR THE LIKE

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[73] Assignee: Fichtel & Sachs AG, Schweinfurt, Germany

[21] Appl. No.: 163,128

[22] Filed: Dec. 7, 1993

[30] Foreign Application Priority Data

Dec. 10, 1992 [DE] Germany 42 41 521.7

[51] Int. Cl.^{6} B60T 11/16

[52] U.S. Cl. .... 188/344; 74/473 R; 74/502.2; 74/502.6; 74/502; 74/501.5 H; 92/137; 188/2 D; 188/24.11

[58] Field of Search .... 74/501.5, 473 R, 502.4, 74/502.6, 502, 501.5 H, 502.2, 501.5 R; 92/137; 280/274, 281.1; 188/2 D, 24.11, 344

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Primary Examiner—Charles A. Marmor
Assistant Examiner—David Fenstermacher
Attorney, Agent, or Firm—Brumbaugh, Graves, Donohue & Raymond

[57] ABSTRACT

A hydraulic actuating device for brakes and gearshifts on bicycles or the like comprises an actuating lever (1*b*), a transmitting cylinder (1*a*), a flexible pressure line (9) and a receiving cylinder (1). The receiving cylinder (1) is connected with a first component (A) of a device to be actuated, and the piston (20) in the receiving cylinder (1) is mechanically connected with a second component (B) of the device by a traction cable (25).

21 Claims, 3 Drawing Sheets

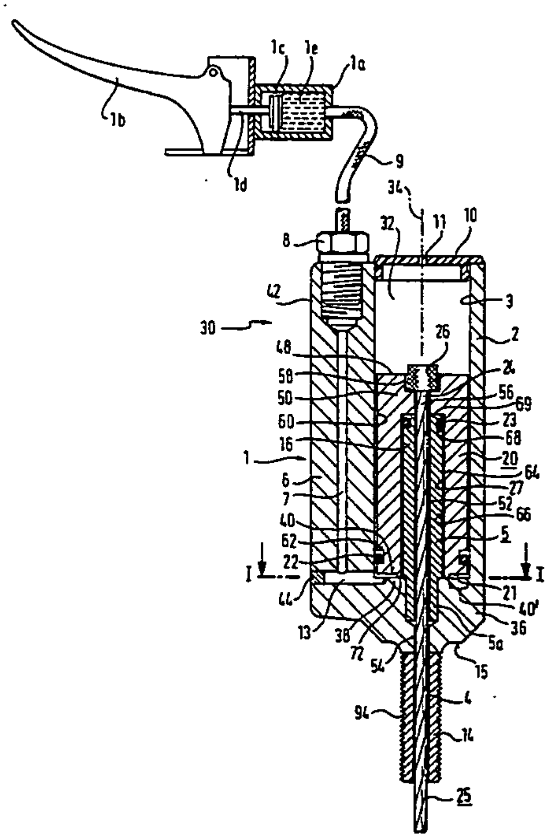

Fig.1

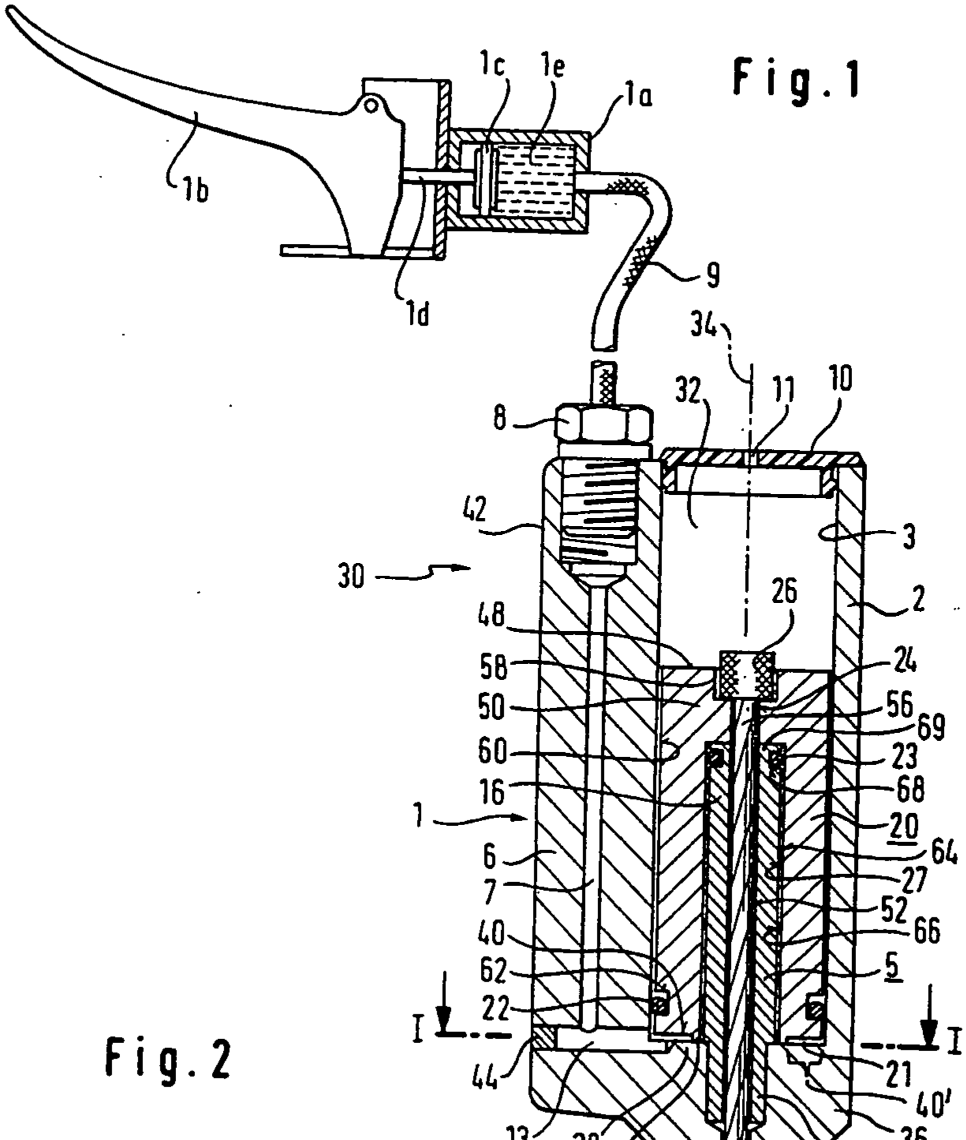
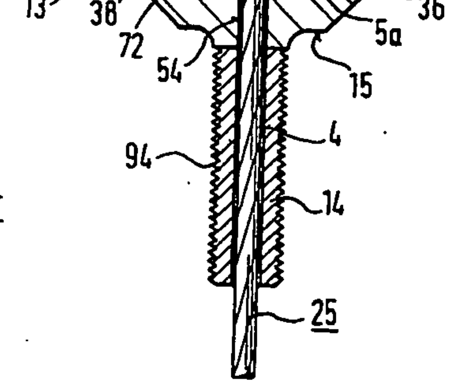
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Fig.2

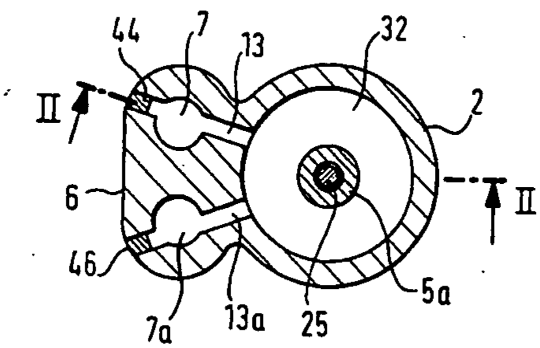
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Fig. 3

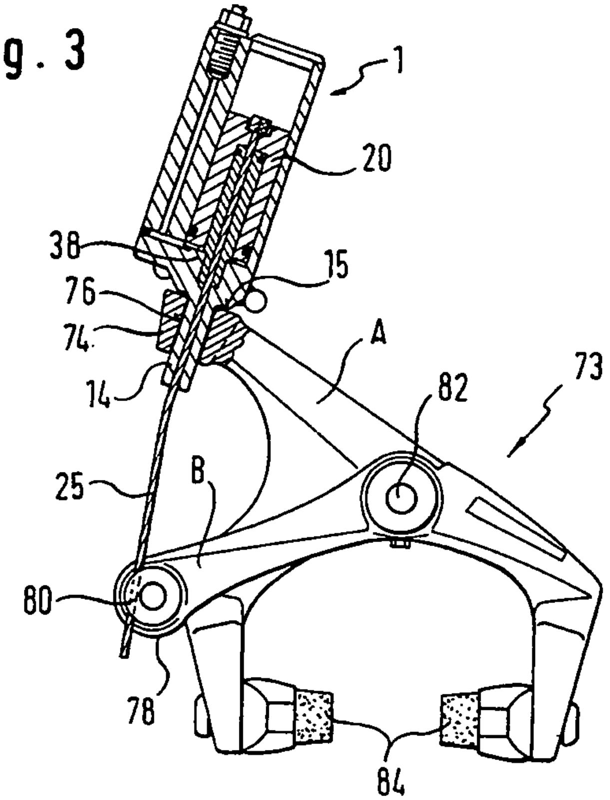


Fig. 4

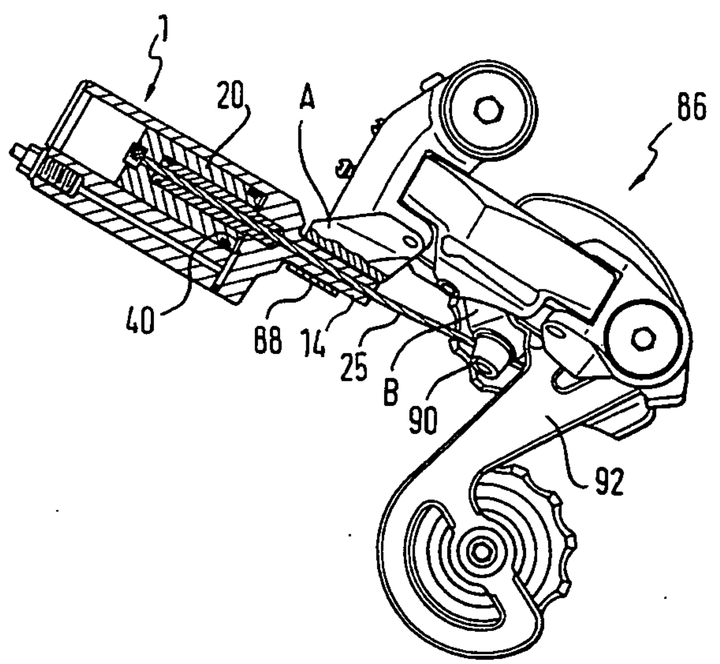
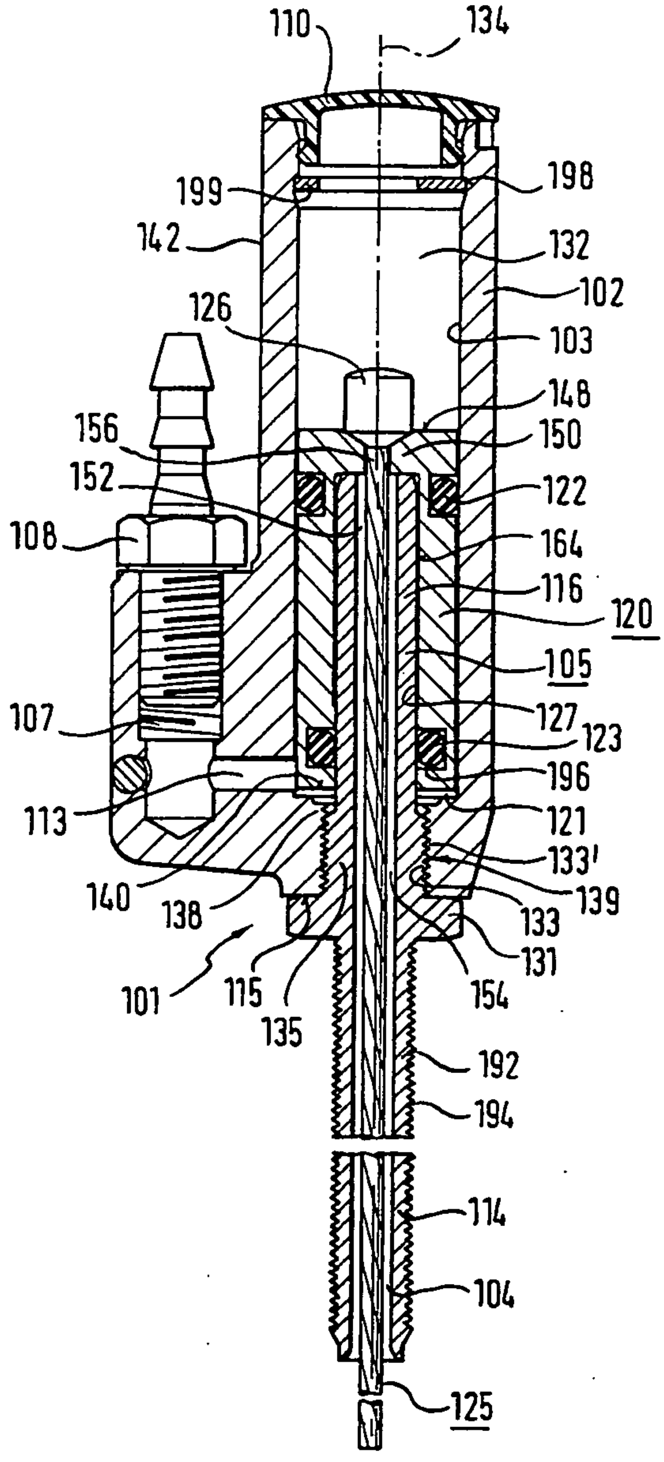


Fig. 5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HYDRAULIC ACTUATING DEVICE FOR BRAKES AND GEARSHIFTS OF BICYCLES OR THE LIKE

BACKGROUND OF THE INVENTION

The present invention relates to a hydraulic actuating device for brakes and gearshifts of bicycles or the like and, in particular, to a device of the type that includes an actuating lever, a transmitting cylinder actuated by the lever, a receiving cylinder, and a flexible pressure line communicating the receiving cylinder and the transmitting cylinder, and that converts the displacement of the transmitting cylinder by the actuation of the actuating lever into displacement of the receiving cylinder in accordance with the diameter ratio between the transmitting cylinder and the receiving cylinder.

An actuating device of the type referred to above is known from, for example, French patent application 85 00 480 (Publication No. 2 575 991). In the actuating device of French Publication No. 2,575,991, a cylinder part of a receiving cylinder is directly connected with a first brake lever part, pivotally mounted on a bicycle frame, and a piston part, which is displaceably received in the cylinder part, is directly connected with a second brake lever part. When a brake handle is actuated, a working fluid is pressurized by the displacement of a piston in a transmitting cylinder and the pressurized working fluid is delivered from the transmitting cylinder. The transmitting cylinder is connected by a hydraulic pressure line with a pressure chamber in the receiving cylinder, so that the working fluid delivered from the transmitting cylinder results in an increase in the amount of working fluid in the pressure chamber of the receiving cylinder. As a result, the piston disposed in the receiving cylinder is displaced by the pressure of the working fluid in the pressure chamber of the receiving cylinder, so that the total length of the receiving cylinder-piston arrangement is increased, whereby the first and second brake lever parts of the bicycle brake are pivoted in respect to each other and in this way result in a braking action.

The known brake device has the disadvantage that it is designed for a force transfer, for example, to the brake lever parts, only through pressure action and that it is designed specially for such brake lever parts. It is required in each case to specially design and manufacture these actuating devices structurally for use as an actuating device for other elements to be operated, thereby resulting in high manufacturing costs, which are particularly crucial in the field mass produced bicycle accessories.

Furthermore, an actuating device for bicycle brakes is known from German Published, Non-Examined Patent Application DE- A-33 03 586, wherein a receiving cylinder is also disposed between two brake lever parts that are pivotally mounted on a bicycle frame, and wherein the increase of the working fluid pressure in a pressure chamber results in an increase of the total length of the-receiving cylinder-piston unit, so that the brake lever parts are again pivoted and result in a braking action. In that known device, too, the receiving cylinder-piston unit is specially designed for use with brake lever parts. A special, different type of design of the receiving cylinder-piston unit is required for use with other components or with brake lever parts of different lever arm lengths, because of which the manufacturing costs for this device are also relatively high.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a hydraulic actuating device that can be used without any special adaptation measures for the actuation of a plurality of different devices which are to be actuated by a mechanical force.

In accordance with the invention, this object is attained in that the cylinder housing part is directly connected with a first component of a device to be actuated (e.g., brake, wheel hub, shift) by a connecting extension, and the piston is mechanically connected by a traction element with a second component of the device to be actuated, which is movable in relation to the first component. In this way it is possible to use the actuating device of the invention with different devices, which are to be operated by means of mechanical force, by connecting it by traction elements with one of the two components which can be moved relative to each other. Thus, the hydraulic actuating device in accordance with the invention can be produced in large quantities and can nevertheless be employed over a great range of uses without the need for special adaptations of the actuating device of the invention. The connection between the actuating device and the second component can be provided in a particularly simple manner in that the piston is directly connected with the second component by a traction cable. Accordingly, no further force transfer means are needed, so that the connection of the device of the invention with, for example, a bicycle brake or the like can be made without any great efforts.

An advantageous arrangement results if the traction cable has a nipple on one of its ends, which is supported on the piston, and the other end of which freely projects from the receiving cylinder for a connection, in particular by clamping, with the second component of the device to be actuated. Furthermore, the traction cable can freely rotate in respect to the piston with its end section connected to the piston, so that no torsional forces build up in the traction cable, which might possibly hamper the operational capabilities of the actuating device in accordance with the invention.

The invention further relates to a piston-cylinder unit for a pressure fluid actuating device, in particular of two-wheeled vehicles or the like, for delivering a fluid under pressure by means of a relative movement between two manually operated components, or for receiving this fluid and the mechanical operation of two components which are to be moved relative to one another. The unit includes a cylinder housing part that defines a cylinder chamber having an axis, the cylinder chamber being closed on one of its axial ends by a cylinder bottom, a piston axially displaceable in the cylinder recess, a pressure chamber formed between a front face of the piston facing the cylinder bottom and the cylinder bottom, and a hydraulic pressure line leading to the pressure chamber for the supply of working fluid into the pressure chamber and for the removal of working fluid from the pressure chamber. The cylinder housing part is connected with a first one of the two components to be actuated, and the piston is connected with a second one of the two components.

The piston has an interior recess parallel to the cylinder axis and open toward the cylinder bottom, which is closed by a piston bottom of the piston at the end of the interior recess facing away from the cylinder bottom. A guide element, which is parallel to the cylinder axis and has a guide section projecting beyond the cylinder bot-

tom and extending into the interior recess, is disposed on the cylinder bottom. The dimension of the guide section parallel to the cylinder axis is greater than a maximum stroke of the piston in the cylinder chamber. Holes extending through the guide element and the cylinder bottom and aligned with one another receive a traction element that is connected between the piston and the second component of the device to be actuated.

Because of the special design of the piston-cylinder unit of the invention, it is possible to connect it on the one hand by the cylinder housing part with the respective components of the device to be operated and, on the other hand, to connect the traction element connected with the piston with the respective component of device to be operated, wherein again the piston-cylinder unit need not be specially designed for a particular device to be operated and instead can be used with a plurality of different devices. Many of these devices, such as brakes and gearshifts, are customarily already designed from the start for actuation by a traction element, in particular Bowden cable elements, so that it is only necessary to fix the Bowden traction core wire to the piston, with a simple support of the cylinder housing part on the support part for the Bowden cable sheath. This makes possible the production of the piston-cylinder unit of the invention in great numbers so that the production costs of the units can be significantly reduced.

In a particularly simple manner, the piston can be connected with the second component by a traction cable.

If the piston bottom has a hole which is aligned with the hole in the guide element, and if the hole in the piston has a section of an enlarged diameter on the front face of the piston facing away from the cylinder bottom, and an end of the traction element connected with the piston has a section of an enlarged diameter which at least partially is disposed in the section with the enlarged diameter in the piston bottom, the traction cable can be connected with the piston in a simple manner, wherein the traction cable is freely rotatable in respect to the piston because of the special type of connection, so that no torsional forces which might hamper the operational capabilities of the piston-cylinder unit can build up in the traction cable.

A particularly desirable embodiment of the cylinder housing part in the guide element can be achieved by making the guide element in one piece with a bottom section which constitutes at least a part of the cylinder bottom. In this case it is advantageous if an opening with an internal thread is provided in the cylinder bottom and if an external thread is provided on the bottom section for screwing the bottom section into the housing part. The cylinder housing part and the guide element with the cylinder bottom can be produced as separate parts and assembled in a simple manner. In this way it is possible in particular to produce the guide element with the bottom section and the cylinder housing part of different materials which are, respectively, adapted to the particular force effects on the two components.

In order to be able, with an embodiment of the cylinder housing part and the guide element with the bottom section as two separate parts, to dispose them in a defined position in respect to each other, it is proposed to provide an insertion-limiting stop extending radially outward on the bottom section.

To connect the cylinder housing part with the first component, it is also proposed to provide a connecting element on an outer surface of the cylinder bottom. The connecting element, preferably, comprises a neck extending axially of the cylinder and having a hole which is aligned with the hole in the cylinder bottom. The traction element passes through the hole in the connecting element and is directly connected with the second component. The force exerted by the piston-cylinder unit of the invention for actuating the first and second components is thus exerted essentially concentrically by the traction element and the connection element which surrounds it, so that no lever effect exists between the traction element and the connecting element which possibly might result in tilting or a lateral force effect on the piston-cylinder unit. Thus, it is possible to achieve a particularly stable construction by making the connecting element unitary with the cylinder bottom.

The piston-cylinder unit may be connected with the first and second components by a sheath section of a Bowden cable, one end of which is fastened to the connecting element and the other end to the first component. The traction element extends through the sheath section of the Bowden cable and forms the core of the Bowden cable. The Bowden cable connection permits the piston-cylinder unit of the invention to be located remote from the first and second components. Thus it is possible to house the piston-cylinder unit at a location where on the one hand it least affects the visual appearance and, on the other, best serves the functionality of the bicycle or the like.

Alternatively, the cylinder housing part may be installed in an opening in the fastening section of the first component by means of a connecting element on the first component, the first component resting against a stop shoulder in the area of the cylinder bottom. This provides a simple way of directly connecting the housing part to the first component, and because of a tensile load of the piston-cylinder unit of the invention, the housing part is held securely in the receiving opening in the fastening section.

It is, furthermore, possible to provide an external thread on the connecting element and an opening with an internal thread on a fastening section of the first component for providing a screw connection between the connecting element and the first component. In this way the cylinder housing part can be fixedly connected with the first component, wherein it is possible, because of the threaded connection of the first component with the cylinder housing part, to set the relative position of these two elements with respect to each other by appropriate turning of the cylinder housing part in the internal thread of the first component and thus to make a simple adjustment of the first and second components in relation to each other.

To assure, in the course of draining of the working fluid out of the pressure chamber formed in the cylinder housing part, that there is always a remaining volume to which the working fluid can be added during a subsequent actuation so that the pressure effect of the cylinder is sufficiently great from the start, it is proposed to provide on the front face of the piston facing the cylinder bottom and/or on the cylinder bottom an annular projection surrounding the interior recess in the piston and axially extending from the front face of the piston.

Alternatively, the guide section may be designed in such a way that it has a length parallel to the axis of the cylinder which is greater than the axial size of the interior recess in the piston. Because of this, when working fluid is drained from the pressure chamber, the piston

can only move so far in the direction of the cylinder bottom until the guide element hits the piston bottom, so that in this case, too, a remaining volume for the subsequent introduction of the working fluid is maintained.

To prevent the escape of working fluid between the piston and the cylinder housing part, it is proposed to provide a groove extending in the circumferential direction in an exterior circumferential surface of the piston for receiving a first sealing element.

Furthermore, to prevent the escape of the working fluid between the piston and the guide element and through the respective holes, it is proposed to provide a groove extending in the circumferential direction in an interior circumferential surface of the interior recess in the piston and/or in an exterior circumferential surface of the guide element for receiving a second sealing element. The seal between the guide element and the piston assures in this case that the escape of working fluid through the holes can be prevented in every axially displaced position of the piston.

To prevent the piston from being displaced out of the cylinder housing part and to ensure that the guide section always remains at least partially in the interior recess of the piston, a stroke-limiting stop element for the piston may be provided in the area of an open end of the cylinder recess in the cylinder housing part. For example, a groove extending in the circumferential direction may be provided for receiving a snap ring in an interior circumferential surface of the cylinder recess of the cylinder housing part in the area of the open end of the cylinder recess. The snap ring can be inserted in a simple manner into the interior circumferential surface during the assembly of the piston-cylinder unit of the invention after insertion of the piston into the cylinder housing part and can subsequently, for example for maintenance on the piston-cylinder unit, again be removed from the groove so that the piston can be taken out of the cylinder housing part.

For a better understanding of the invention, reference may be made to the following description of exemplary embodiments, taken in conjunction with the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a generally schematic longitudinal cross-sectional view of a first embodiment of a hydraulic actuating device in accordance with the invention taken along the line II—II of FIG. 2;

FIG. 2, a cross-sectional view taken through a receiving cylinder of the embodiment of FIG. 1 along the line I—I in FIG. 1;

FIG. 3 is an elevational view, with portions broken away in cross section, of a receiving cylinder in accordance with the invention coupled to a bicycle brake;

FIG. 4 is and elevational view, with portions broken away in cross section, of a receiving cylinder in accordance with the invention coupled to a derailleur; and

FIG. 5 is a longitudinal cross-sectional view corresponding to FIG. 1 of a second embodiment of the receiving cylinder in accordance with the invention.

DESCRIPTION OF THE EMBODIMENTS

Referring to FIG. 1, an embodiment of the actuating device 30 comprises an actuating lever 1*b*, which can be a brake lever, for example, suitably attached in the grip area of a bicycle handlebar, and a transmitting cylinder 1*a*, in which a piston 1*c* is displaceably disposed. The piston 1*c* is connected with the actuating lever 1*b* by a piston rod 1*d*, so that by moving the actuating lever 1*b*, the piston 1*c* in the cylinder 1*a* is displaced to increase or decrease of the volume of a pressure chamber 1*e*. The pressure chamber 1*e* of the cylinder 1*a* is filled with a working fluid. In the hydraulic actuating device shown in FIG. 1, the cylinder 1*a* is used as a transmitting cylinder and delivers working fluid under pressure through a flexible pressure line 9 to a receiving cylinder 1 when the actuating lever is moved.

The receiving cylinder 1 comprises a cylinder housing part 2 that defines an elongated cylinder chamber 32 having an axis 34. The cylinder chamber 32 is closed at one axial end 36 of the cylinder housing part 2 by a cylinder bottom 38. A piston 20 is disposed for displacement in the axial direction in the cylinder chamber 32. A pressure chamber 21 is defined between a front face 40 of the piston 20, which faces the cylinder bottom 38 and the cylinder bottom 38. Working fluid is supplied to, or removed from, the pressure chamber through a fluid supply conduit, which is formed by bores 7 and 13 in a supply housing portion 6 of the cylinder housing part 2. The bore 7 is disposed in the cylinder housing part 2 in such a way that it extends essentially parallel with the axis 34 of the cylinder chamber 32, and a connecting element 8 for connecting the pressure line 9 with the fluid supply conduits 7, 13 is installed on an end 42 of the cylinder housing part 2 opposite the piston bottom 38.

A fluid supply conduit can be provided in a simple way by means of the bores 7 and 13 which are in communication with each other, wherein the bore 13 which essentially extends radially of the cylinder chamber 32, as can be seen particularly in FIG. 2, is closed at its end remote from the chamber 32 by a plug 44.

Bores 7*a*, 13*a*, which are similar to the bores 7, 13, are provided in the housing part 2, the bore 13*a* being closed by a plug 46. The bores 7*a*, 13*a* constitute a vent passage that leads from the pressure chamber 21 to the upper end 42 of the cylinder housing part 2 and is normally closed by, for example, a vent screw (not visible in the drawing figure).

A guide element 5 mounted on the cylinder bottom 38 has a guide portion 16 that extends parallel to (or coincident with) the cylinder axis 34 into the cylinder chamber 32. An interior recess 27 is provided in the piston 20 and is open toward the front face 40 of the piston opposite the cylinder bottom 38. The interior recess 27 is closed by a piston bottom 50 at its end facing away from the cylinder bottom 38. The cross section of the interior recess 27 corresponds essentially to the cross section of the guide portion 16 of the guide element 5, and the guide portion 16 extends at least partially into the interior recess 27.

Holes 24, 52 and 54 that are aligned with each other and are substantially parallel to or coincident with the cylinder axis 34 are provided in the piston bottom 50, in the guide element 5 and in the cylinder bottom 38, respectively. A traction element, for example a traction cable 25, extends through the holes 24, 52 and 54. On one end 56, the traction cable 25 has a section 26 of an enlarged diameter, for example a nipple 26, which is disposed in a corresponding cavity 58 in the front face 48 of the piston bottom 50. The traction cable 25 is used to connect the piston 20 to a device to be actuated, as described in detail below.

A neck 14 with a hole 4 that is aligned with the hole 54 in the cylinder bottom is provided on the side of the

cylinder bottom 38 opposite the cylinder chamber, and the traction cable passes through the hole 4. The neck 14, as described below, provides for the mounting of the receiving cylinder on the device to be actuated.

To prevent the escape of the working fluid from the pressure chamber 21 between the external circumferential surface 60 of the piston 20 and the internal circumferential surface 3 of the cylinder chamber 32, a circumferential groove 62 is provided in the external circumferential surface 60 of the piston 20, in which a sealing element, for example an elastic seal ring 22, is disposed. The seal ring 22 assures a tight closure between the external circumferential surface 60 of the piston 20 and the internal circumferential surface 3 of the cylinder chamber 32.

Furthermore, to prevent escape of the working fluid from between the internal circumferential surface 64 of the piston recess 27 and the external circumferential surface 66 of the guide portion 16 of the guide element 5 and through the holes 52, 54 and 4, a circumferential groove 68 is provided in the external circumferential surface 66 of the guide element 5 near the end 69, in which a sealing element, for example an elastic seal ring 23, is disposed.

When the actuating lever 1*b* of the transmitting cylinder is moved to displace the piston 1*c* along the cylinder 1*a* in a direction to provide fluid delivery from the transmitting cylinder 1*a*, working fluid flows through the pressure line 9 and the fluid supply conduits 7, 13 into the pressure chamber 21 in the receiving cylinder 1. The flow of pressurized working fluid into the chamber 21 displaces the piston 20 in a direction toward the end 42 of the cylinder housing part 2, which produces a simultaneous displacement of the traction cable 25. Thus, the traction cable 25 moves in relation to the neck 14, and this relative movement is used in a manner described below for the actuation of two components of the device to be actuated, which move relatively to one another.

The seal ring 23 on the guide element 5 assures a tight seal of the pressure chamber in respect to the holes 52, 54 and 4 in every axial position of the piston 20 in the cylinder chamber 32. To this end, it is necessary that the length of the guide portion 16 of the guide element 5 extending into the interior recess 27 be greater than the maximum stroke of the piston 20 in the cylinder chamber 32 and that the seal ring 23 be disposed as close as possible to the end 68 of the guide portion 16 which is remote from the piston bottom 38. When the actuating lever 1*b* is released, the piston is returned in the direction of the cylinder bottom 38, for example by the energy stored in a spring, not shown, of the device actuated by the receiving cylinder.

An annular projection 72 on the front face 40 of the piston 20 surrounding the interior recess 27 in the piston 20 prevents the front face 40 from resting with its entire surface on the cylinder bottom 38. In this way the fluid introduced into the pressure chamber 21 is evenly distributed over the entire surface of the front face 40 of the piston 20 in the course of a subsequent actuation by the actuating lever 1*b*, and provides a uniform force of the face 40 from the start of the introduction of the working fluid into the pressure chamber 21.

As can further be seen in FIG. 1, the guide element 5 has an end section 5*a* which is received in a corresponding recess in the cylinder bottom and is fixed in this recess, for example by gluing, soldering or the like.

The end of the cylinder chamber 32 opposite from the bottom 36 is closed by a cover 10 in the area of the end 42 of the cylinder housing part 2. The cover 2 prevents dirt and dust from entering the interior of the cylinder chamber 32 and thereby from hampering the free movement of the piston 20 in the cylinder chamber 32. A vent opening 11 is provided in the cover 10, through which air can flow in and out of the chamber during movements of the piston 20. In this way, pressure changes in the section of the chamber 32 between the piston 20 and the cover 10 during movements of the piston 20, which would affect the functional capability of the receiving cylinder 1, are prevented.

Examples of the use of the receiving cylinder of the invention are illustrated in FIGS. 3 and 4, respectively. In FIG. 3, the receiving cylinder 1 is employed with a caliper-type rim brake 73 of a bicycle. Such rim brakes are per se well known to those skilled in the art and a detailed description need not be provided here. A first brake lever arm A of the rim brake 73 has a fastening section 74 in the form, for example, of a mounting hole 76. The neck 14 of the receiving cylinder 1 is received in the hole 76 and rests with a shoulder 15 engaged against the fastening section 74 of the brake lever arm A. The position of the receiving cylinder 1 relative to the brake lever arm 1 can be set, for example, by shims (not shown) between the shoulder 15 and the fastening section 74 of the arm A.

A second brake lever arm B has a second fastening section 78, to which the traction cable 25 is secured, for example, by a clamping screw 80. Upon actuation of the actuating lever 1*b* and the movement of the piston 20 away from the cylinder bottom 38 connected therewith, the two fastening sections 74, 78 of the brake lever arms A, B are moved toward each other, based on the relative movement between the neck 14 and the traction cable 25, because of which the brake lever arms A, B are pivoted around a pivot axis 82 and the brake shoes 84 are brought in contact with a rim, not shown. The frictional force generated between the rim and the brake shoes 84 results in braking.

It is possible by a suitable selection of the ratio of the interior cross-sectional area of the delivery cylinder 1*a* to the area of the annular piston face 40 of the piston 20 of the delivery cylinder, which is equal to the cross-sectional area of the cylinder 32 minus the cross-sectional area of the interior recess 27 of the piston 20, to increase the force introduced into the cylinder 1*a* through the actuating lever 1*b*. To this end, the annular piston face area is made larger than the cross-sectional surface of the piston 1*c* in the cylinder 1*a*. Although, when the actuating lever 1*b* is operated, the stroke of the piston 20 will be less than the stroke of the piston 1*c*, caliper-type rim brakes of this type do not require a large stroke or a large pivot movement of the brake lever arms A and B.

In FIG. 4, the receiving cylinder of the invention is shown with a chain thrower 86 of a derailleur of a bicycle. Chain throwers of this type are known from the prior art, and a detailed description here is not necessary and not provided. The chain thrower 86 has two components A, B, which are to be moved in relation to each other, the component A having a first fastening section 88 into which the neck 14 of the receiving cylinder 1 can, for example, be inserted in a manner analogous to FIG. 3. A clamping screw 90 is again provided on the second component B, by means of which the traction cable 25 is fastened to the component B.

When the actuating lever $1b$ (FIG. 1) is moved, the components A and B are moved toward each other because of the relative movement between the neck 14 of the receiving cylinder 1 and the traction cable 25. By means of the coupling mechanism, known per se, of such chain throwers, a chain guide section 92 is then laterally pivoted, i.e. orthogonally to the plane of the paper in FIG. 4, which results in switching between different steps of sprockets.

With such chain throwers, in particular with sprockets of, for example, seven or eight sprocket wheels on one rear wheel hub, a large lateral travel of the chain guide section 92 is required. This can be achieved in a manner analogous to FIG. 3 in that the annular piston face area 40 in the receiving cylinder piston 20 is made smaller than the cross-sectional surface of the piston $1c$ in the transmitting cylinder $1a$. Although in such a case the actuating force of the receiving cylinder 1 is reduced in relation to the force introduced into the receiving cylinder, the chain throwers 86 for derailleurs do not require a large force for operation.

Instead of inserting the neck 14 of the receiving cylinder 1 into the fastening sections 74, 88 of the rim brake 73 or the chain thrower 86, it is also possible to provide an exterior thread 94 (FIG. 1) on the neck 14 and to provide an interior thread in the respective openings in the fastening sections 74 or 88 for screwing the neck 14 into the respective fastening section. Thus it is possible to attach the receiving cylinder 1 on the fastening section so that it is adjustable in its position relative to the respective lever arm and can be secured against unintentional loosening from the respective fastening section by a lock nut, for example. In this way, it is possible to fix the position of the receiving cylinder in relation to the respective component, by means of which it is also possible to adjust the position in relation to each other of the two components to be actuated.

A second embodiment of the receiving cylinder is illustrated in FIG. 5. The components of FIG. 5 which correspond to the components in FIG. 1 have been designated by the same reference numerals, increased by 100. In the embodiment of FIG. 5, only the guide part 105 and the neck 114 differ from FIG. 1. The remaining structure of the receiving cylinder 101 essentially corresponds to the construction of the receiving cylinder 1, so that regarding its construction reference is made to the above description in connection with FIGS. 1 and 2.

As can be seen in FIG. 5, a hole 139 is provided in the cylinder bottom 138, which has a somewhat larger cross section than the hole 54 of the cylinder bottom 38 of FIG. 1. An internal thread 133' is provided on the wall of the hole 139. The guide element 105 has a section 135 with an external thread 133 that is screwed into the hole 139; the section 135 thus forms a part of the cylinder bottom 138.

An annular, outwardly extending flange portion 131 on the guide element 105 engages a stop surface 115 when the guide element 105 is screwed into the hole 139. Such engagement ensures the accuracy of assembly of the receiving cylinder 101 and makes the assembly easier.

The guide element 105 is unitary with the neck 114, which has a section 192 extending to the outside of the cylinder chamber 132 through an opening 139. The receiving cylinder 101 can be attached to the respective component to be actuated by means of the neck 114, as described above and shown in FIGS. 3 and 4. The neck 114 of FIG. 5 has an external thread 194 that permits it to be screwed into a connecting opening of a fastening section with an interior thread, for example. By providing a lock nut, not shown in the drawing figures, it is possible to fix the entire receiving cylinder 101 in a selected position relative to the fastening section by rotating the neck 114 in the receiving opening (not shown) of the component, and it can be fixed in any desired position by the lock nut. In this way an adjustment of the positions of the components which are to be moved towards each other becomes possible.

As can be seen in FIG. 5, the seal ring 123 is disposed in a circumferential groove 196 in the internal surface 164 of the interior recess 127 in the piston 120. In this way the seal rings 122, 123 are both provided on the piston 120. Furthermore, a circumferential groove 198, in which a snap ring 199 is disposed, is provided in the area of the end 142 of the cylinder housing part 102 in the interior circumferential surface 103 of the interior chamber 132. The snap ring 199 forms a stroke-limiting stop for the piston 120, so that the piston cannot be displaced so far that it is dislodged from the guide element 105.

As can further be seen in FIG. 5, no annular projection corresponding to the annular projection 72 in FIG. 1 is provided on the front face 140 of the piston 120. In the lowest piston position of the embodiment illustrated in FIG. 5 there is a remaining volume of the pressure chamber 121 formed between the cylinder bottom 138 and the piston 120, because the length of the guide section 116 extending into the cylinder chamber 132 is greater than the length of the interior recess 127 in the piston 120. In this piston position, the piston bottom 150 rests against the guide section 116, because of which the further movement of the piston 120 in the direction toward the cylinder bottom 138 is blocked.

The embodiment of FIG. 5 has the advantage that the guide element 105 with the bottom section 135 and the neck 114 can be manufactured as a separate part and that it is therefore possible to use a different material for the guide element 105 than for the cylinder housing part 102. Exterior forces act on the neck 114, so that it is advantageous to make it of a harder material than the cylinder housing part 102. For example, the guide element 105 with the bottom section 135 and the neck 114 can be manufactured of steel, and the cylinder housing part of a light metal such as aluminum. The total weight of the receiving cylinder of the invention is relatively low, while it is sufficiently strong.

Because of the provision of the seal ring 123 on the piston 120, no steps for providing such a sealing ring on the guide element 105 need to be taken, so that the manufacture of the guide element 105 consisting of a harder metal can be simplified.

The hydraulic actuation devices in accordance with the invention allow the employment of one and the same actuation device in different devices to be actuated. Such devices to be actuated comprise, for example, gearshifts or brakes of bicycles. The receiving cylinder of the hydraulic .actuating device of the invention can be attached in a simple manner to the respective devices to be actuated, and the type of attachment essentially corresponds to the attachment of a Bowden cable sheath which had been used up to now. In this way the employment of the actuating device of the invention is also possible with brakes or gearshifts already installed on a bicycle, for example. This is additionally aided by the respective disposition of the pres-

sure line and the neck or traction cable in the axial direction of the receiving cylinder in the area of the receiving cylinder. If necessary, the pressure line can be fixed on the frame of the two-wheeled vehicle by means of the fastening element provided for the Bowden cable. However, it is also possible to guide the pressure line away from the cylinder housing part at an angle in respect to the traction cable which is different from 180°.

The receiving cylinder **1** or **101**, illustrated in FIGS. 1 to 5 and described in detail above, can also easily be used as a transmitting cylinder in an actuating device, in particular in place of the transmitting cylinder *1a* of FIG. 1. To do this it is only necessary to connect the corresponding actuating handle with the piston **20** or **120** via the traction cable, along with a corresponding hinging of the actuating handle on the handlebar in such a way that the traction cable is stressed by tension when the handle is actuated.

Since one and the same receiving cylinder can be used for a plurality of applications, the costs for manufacturing the actuation device in accordance with the invention can be significantly reduced because of mass production. Different delivery cylinders, having areas that provide the desired stroke ratio for different applications of the same delivery cylinder, can be used for different applications.

Based on the selection of the effective cross-sectional surfaces of the pistons of the delivery cylinder and the receiving cylinder, the hydraulic actuation device can easily be adapted in a simple manner to different requirements which, for example, can include a large force of the receiving cylinder with a short stroke or a relatively small force of the receiving cylinder with a long stroke.

Use of the actuation device of the invention makes it possible, moreover, to replace the Bowden cable transmissions, which have been customary on bicycles up to now, to a large extent with the pressure lines of the actuating device, thus removing the frictional force losses of the Bowden cable device which occur, particularly with a multitude of turns. With a clearly reduced actuating force, the devices operated by means of the actuating devices in accordance with the invention therefore exhibit a considerably improved or strengthened effect (for example braking effect) with great dependability, even after prolonged use.

We claim:

1. A hydraulic actuating device for brakes and gearshifts on bicycles, comprising an actuating lever, a transmitting cylinder coupled to the actuating lever, a receiving cylinder for converting the displacement of the transmitting cylinder by the actuation of the actuating lever into displacement of the receiving cylinder in accordance with the ratio of the areas of the transmitting cylinder and the receiving cylinder, and a flexible pressure line communicating the transmitting cylinder and the receiving cylinder, wherein the receiving cylinder includes a cylinder housing part and a piston; the cylinder housing part being directly connected with a first fastening section of a first component of a device to be actuated by a connecting extension and being stationary with respect to the first component upon actuation of the actuating lever, and the piston being mechanically connected by a traction element with a second fastening section of a second component of the device which is movable in relation to the first component for generating a pulling force between the first and second fastening portions in order to reduce the distance between the first and second portions upon actuation of the actuating lever.

2. The hydraulic actuating device in accordance with claim **1**, wherein the piston is directly connected with the second component by a traction cable.

3. The hydraulic actuating device in accordance with claim **2**, wherein the traction cable has a nipple on one end engaging the piston, and wherein another end of the traction cable extends from the receiving cylinder for a connection with the second component of the device to be actuated.

4. A piston-cylinder unit for a pressure fluid actuating device of two-wheeled vehicles for delivering a fluid under pressure by means of a relative movement between two manually operated components, or for receiving a fluid and the mechanical operation of two components which are to be moved relative to one another, comprising a cylinder housing part with a cylinder chamber having an axis, the cylinder chamber being closed on one of its axial ends by a cylinder bottom, a piston axially displaceable in the cylinder chamber, a pressure chamber formed between a front face of the piston facing the cylinder bottom and the cylinder bottom, and a hydraulic pressure line communicating with the pressure chamber for the supply of working fluid into the pressure chamber and for the removal of the working fluid from the pressure chamber, wherein the cylinder housing part is connected with a first one of the two components and the piston is connected with a second one of the two components, wherein the piston has an interior recess parallel to the cylinder axis and open toward the cylinder bottom which is closed by a piston bottom of the piston at an end of the interior recess facing away from the cylinder bottom, a guide element which is parallel to the cylinder axis and has a guide section projecting beyond the cylinder bottom and extending into the interior recess and disposed on the cylinder bottom, the dimension of the guide section parallel to the cylinder axis being greater than a maximum stroke of the piston in the cylinder chamber, a guide element hole extending through the guide element and a cylinder bottom hole extending through the cylinder bottom, the guide element hole and cylinder bottom hole being in alignment with one another and receiving a traction element that is connected between the piston and the second component.

5. The piston-cylinder unit in accordance with claim **4**, wherein the traction element is a traction cable.

6. The piston-cylinder unit in accordance with claim **4**, wherein the piston bottom hole has a section of an enlarged diameter on a front face of the piston facing away from the cylinder bottom and an end of the traction element connected with the piston has a section of an enlarged diameter which at least partially is disposed in the section with the enlarged diameter of the piston bottom hole.

7. The piston-cylinder unit in accordance with claim **4**, wherein the guide element is unitary with a bottom section which constitutes at least a part of the cylinder bottom.

8. The piston-cylinder unit in accordance with claim **7**, wherein an opening with an internal thread is provided in the cylinder housing part and an external thread is provided on the bottom section for screwing the bottom section into the cylinder housing part.

9. The piston-cylinder unit in accordance with claim **8**, wherein a stop flange extending radially outward is

provided on the bottom section for engagement with the cylinder housing part.

10. The piston-cylinder unit in accordance with claim 4, wherein a connecting element for connecting the cylinder housing part with the first component is provided on the outside of the cylinder bottom.

11. The hydraulic actuating device in accordance with claim 10, wherein the connecting element has a neck extending in the direction of the cylinder axis and a connecting element hole which is aligned with the cylinder bottom hole, and the traction element passes through the connecting element hole and is directly connected with the second component.

12. The hydraulic actuating device in accordance with claim 10, wherein the connecting element is unitary with the bottom section.

13. The hydraulic actuating device in accordance with claim 10, wherein a sheath section of a Bowden cable is fastened at one end to the connecting element and at another end to the first component, and the traction element extends through the sheath section of the Bowden cable and forms a core of the Bowden cable.

14. The hydraulic actuating device in accordance with claim 10, wherein the cylinder housing part is received in an opening on a first fastening section of the first component by means of the connecting element on the first component, and the first component rests against a stop surface in the region of the cylinder bottom.

15. The hydraulic actuating device in accordance with claim 10, wherein an external thread is provided on the connecting element and an opening with an internal thread is provided on a fastening section of the first component for providing a screw connection between the connecting element and the first component.

16. The hydraulic actuating device in accordance with claim 4, wherein an annular projection on the piston surrounds the interior recess in the piston and axially extends from the front face of the piston toward the cylinder bottom.

17. The hydraulic actuating device in accordance with claim 4, wherein the axial length of the guide section is greater than the axial length of the interior recess in the piston.

18. The hydraulic actuating device in accordance with claim 4, wherein a groove extending in the circumferential direction is provided in an exterior circumferential surface of the piston for receiving a first sealing element.

19. The hydraulic actuating device in accordance with claim 4, wherein a groove extending in the circumferential direction is provided in at least one of an interior circumferential surface of the interior recess in the piston and an exterior circumferential surface of the guide element, and a second sealing element is received in the groove.

20. The hydraulic actuating device in accordance with claim 4, wherein a stroke-limiting element is provided for the piston in the area of an open end of the cylinder chamber in the cylinder housing part.

21. The hydraulic actuating device in accordance with claim 20, wherein a groove extending in the circumferential direction for receiving a snap ring is provided on an internal circumferential surface of the cylinder chamber of the cylinder housing part in the area of the open end of the cylinder chamber.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 5,443,134

DATED : August 22, 1995

INVENTOR(S) : Joachim Gajek and Hannsjörg Stumpf

It is certified that error appears in the above-indentified patent and that said Letters Patent is hereby corrected as shown below:

Col. 1, line 51, "field" should read --field of--;
Col. 5, line 56, "and" should read --an--;
Col. 6, line 4, "of the" should read --the--;

Col. 13, claims 11 through 21, "The hydraulic actuating device" should read -- The piston cylinder unit --.

Signed and Sealed this

Fifth Day of March, 1996

Attest:

Bruce Lehman

BRUCE LEHMAN

Attesting Officer

Commissioner of Patents and Trademarks

United States Patent [19]

Sule

[11] **Patent Number:** 4,896,753

[45] **Date of Patent:** Jan. 30, 1990

[54] **BICYCLE BRAKE**

[76] Inventor: Sandor Sule, Huttenlebenweg 42, CH-8240 Thayngen, Fed. Rep. of Germany

[21] Appl. No.: 175,531

[22] Filed: Mar. 31, 1988

[30] **Foreign Application Priority Data**

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Apr. 15, 1987 [DE] Fed. Rep. of Germany 3712734

[51] Int. Cl.⁴ B60T 11/16

[52] U.S. Cl. 188/344; 92/40; 92/44; 92/94; 92/101; 188/24.19

[58] Field of Search 188/344, 24.19, 24.22, 188/26; 60/533; 92/36, 40, 44, 90, 94, 101

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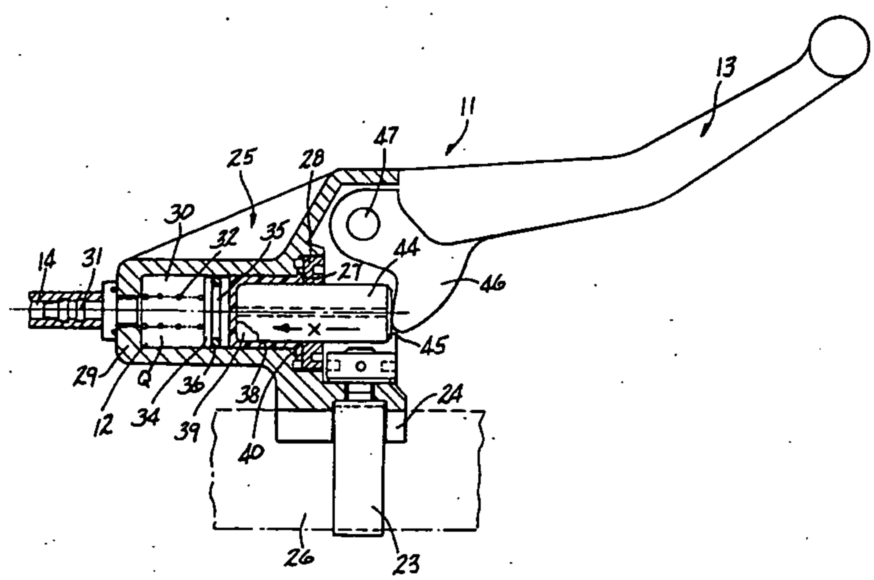
Primary Examiner—George E. A. Halvosa
Attorney, Agent, or Firm—Bachman & LaPointe

[57] **ABSTRACT**

A bicycle brake system with at least one master cylinder that is connected to a hand lever, and at least one wheel cylinder that is connected thereto by a hydraulic brake line is to be improved in that a hollow body (38) that is of elastic material and closed at one end is installed in a master cylinder (12); in that interior space (39) accommodates a pushrod (44) that is adjacent to the hand lever (13) and its closed face end (37) rests against a piston (34) that is supported against the accumulator within the reducible pressure chamber (30) of the master cylinder.

14 Claims, 5 Drawing Sheets



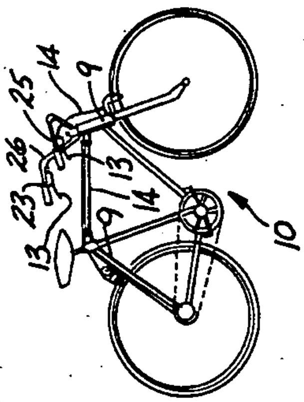


FIG-1

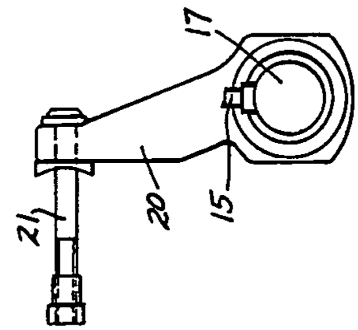


FIG-4

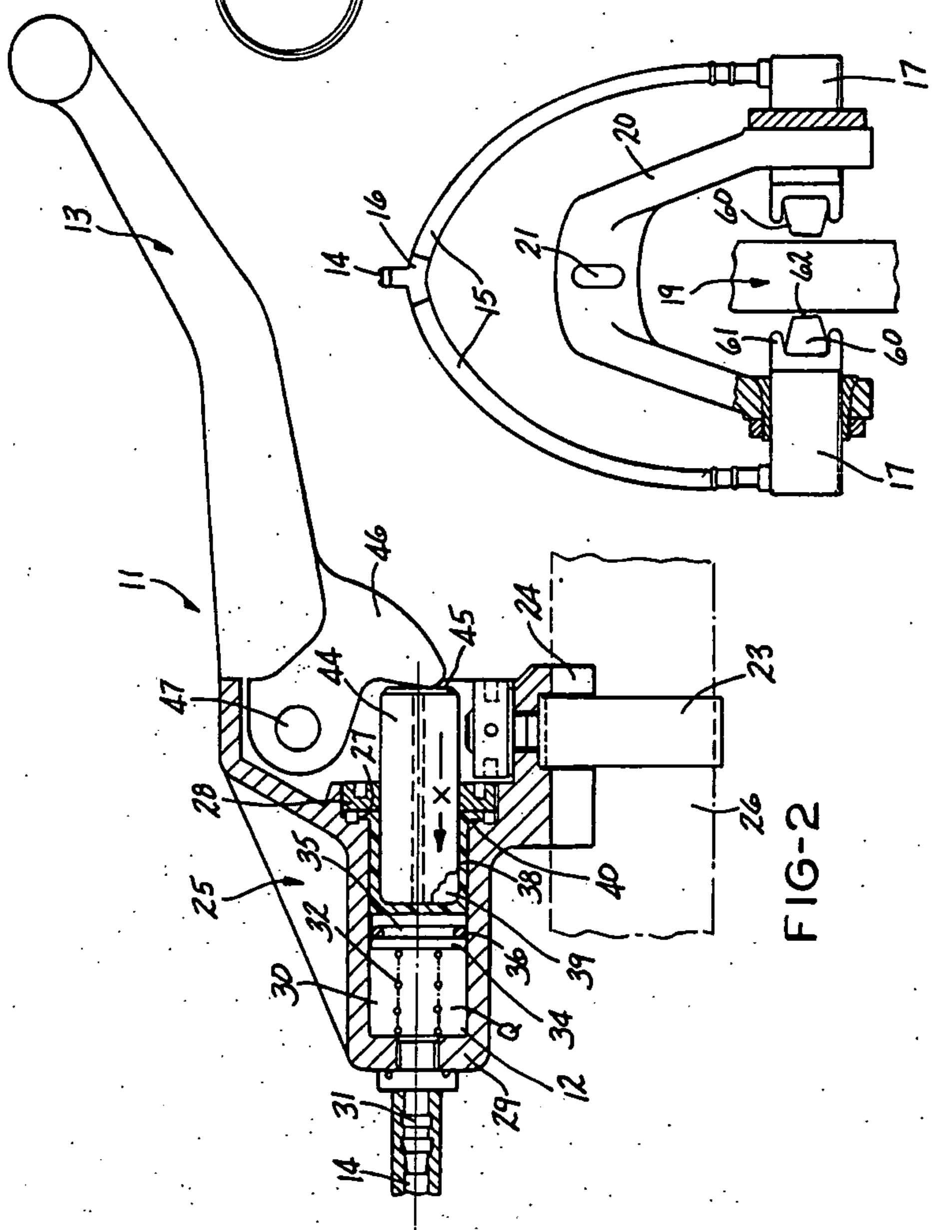


FIG-2

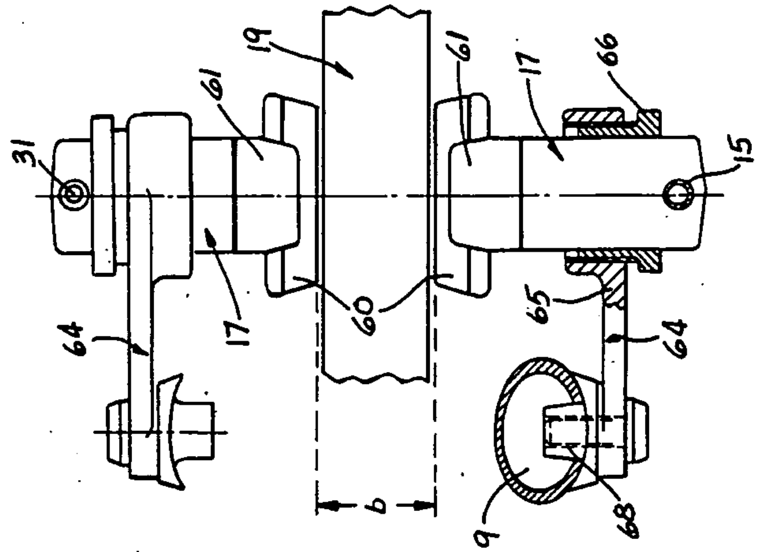


FIG-6

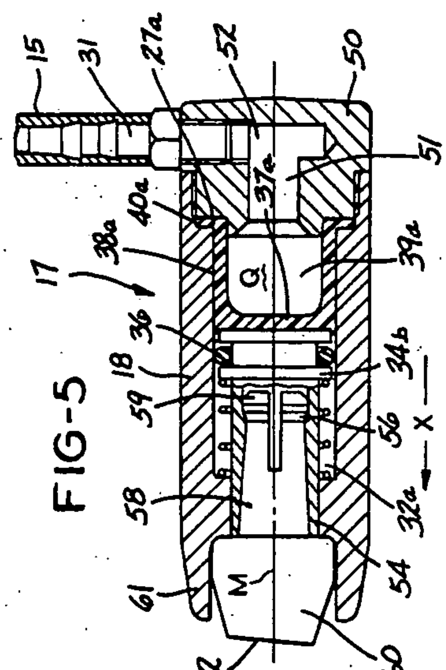


FIG-5

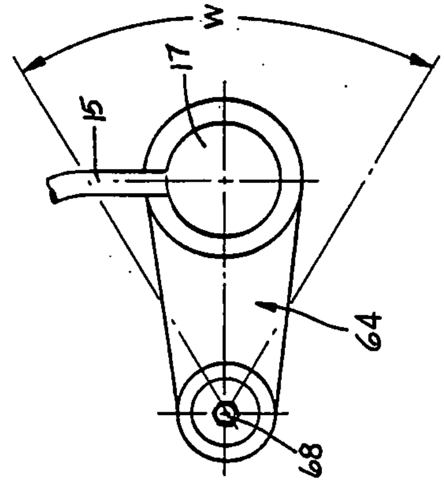


FIG-7

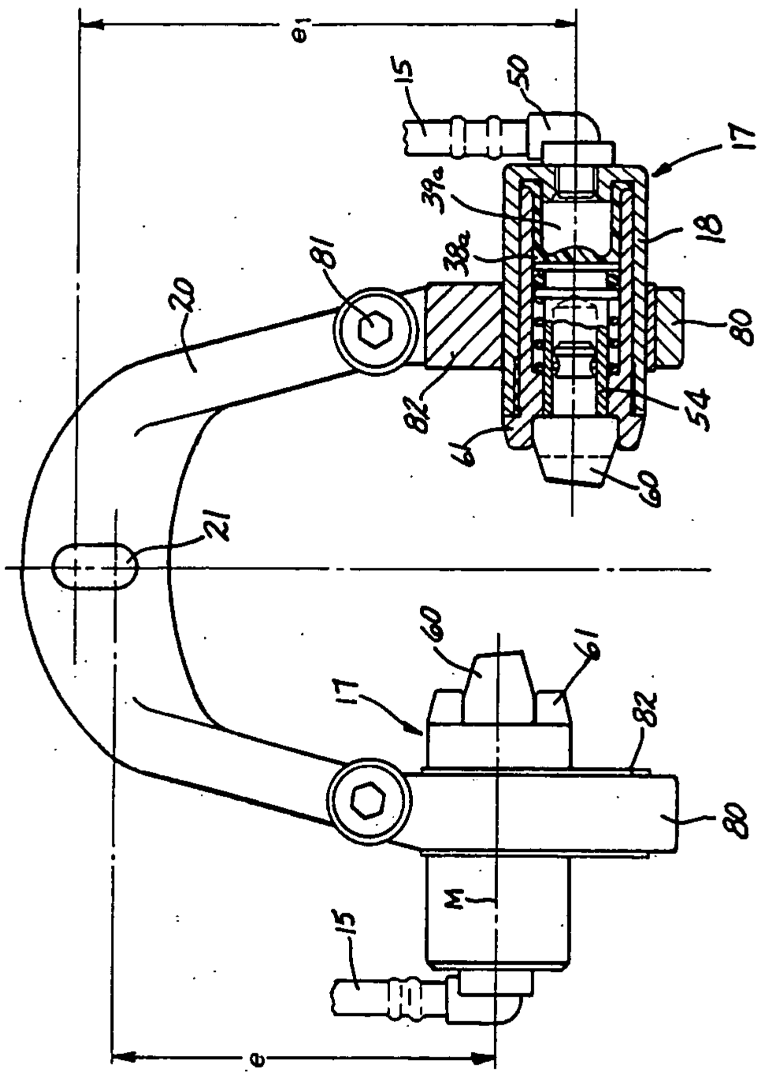


FIG-8

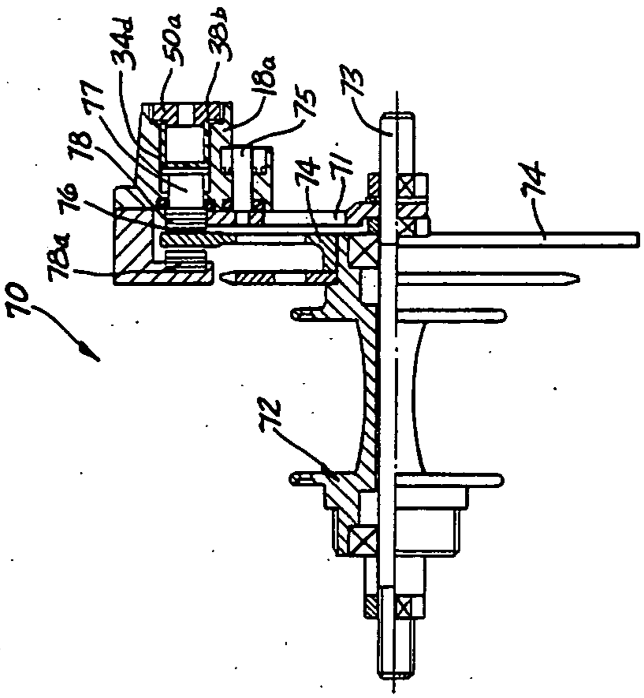


FIG-10

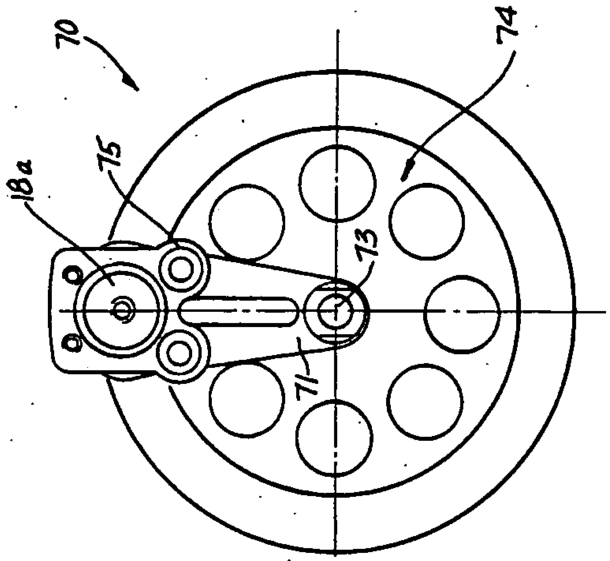


FIG-9

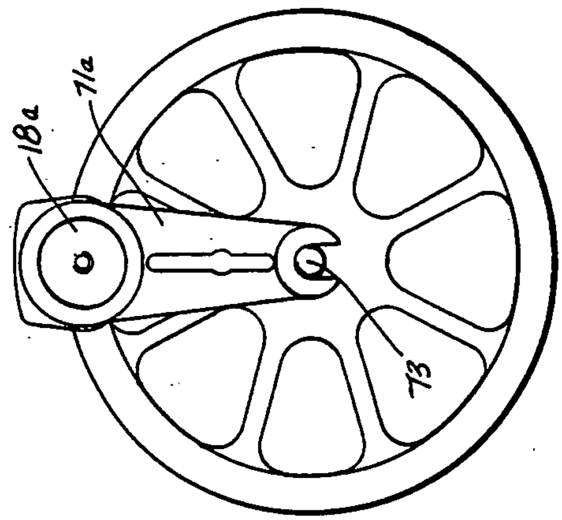


FIG-11

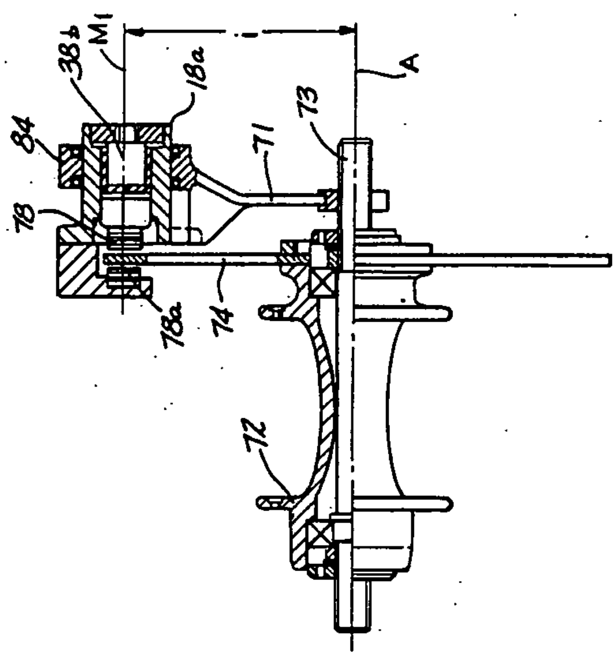


FIG-12

BICYCLE BRAKE

BACKGROUND OF THE INVENTION

The present invention relates to a bicycle brake system with at least one master cylinder that is connected to a hand lever, and at least one wheel cylinder that is connected thereto by a hydraulic brake line, said brake line opening out at both ends into a space of variable volume, it being possible to reduce the volume of the space within the master cylinder by means of an organ operated by a hand lever against an accumulator.

A bicycle brake of this kind is known from Swiss Patent 581 556; this has two opposing wheel cylinders that act on both sides of the wheel. The brake pads are operated by the pressure of the fluid in the pressurized-fluid system against the return force of a spring or the like, the pressurized-fluid system being activated against the master cylinder.

In view of this prior art, it is the aim of the present invention to improve a bicycle brake system of this kind and ensure total freedom from leaks. In addition, the brake system is to be of simple construction and require only a few component parts.

SUMMARY OF THE INVENTION

According to the present invention, in order to solve this task, a hollow body of elastic material, closed at one end, is so secured in its open area, within the master cylinder, that its internal space accommodates a pushrod that abuts against the hand lever, and its closed face end lies against a piston that is supported by the accumulator. The interior space of the wheel cylinder is fitted with a preferably like-shaped elastic hollow body, and the brake line opens out into the interior space within said hollow body; thus the interior space is acted upon by the fluid, and as the pressure of said fluid increases it forces the brake pads against the opposite surface on the wheel with its closed face end.

Here, it has been made possible that with a single element, the problem of fluid sealing in a hydraulic bicycle brake has been solved in an extremely simple manner. In the master cylinder, the interior space of the hollow body is not a part of the fluid system, but is a receiving organ for the pushrod that can be moved axially by the hand lever. Within the master cylinder, the brake fluid flows within the master cylinder, outside the hollow body, into a cylinder space that contains the spring for returning the elastic hollow body into the starting position.

In the wheel cylinder, the interior space of the hollow body, which is in the form of a cap, is once again part of the fluid system and the return spring lies outside the fluid system and preferably encloses a mounting shaft for the brake pads.

Additional features of the present invention are set out herein.

Thanks to this system, it is now possible to effect precise braking processes without failures. The brake system according to the present invention is cost effective, easy to maintain, and can be retrofitted to any kind of bicycle, whether fitted with an auxiliary engine or not.

Of independent inventive significance is the configuration of a disk brake wherein the hollow body of a wheel cylinder is associated with a brake pad of a disk brake, said brake pad acting at right angles to the plane of the disk, close to the edge of said disk. The brake pad is part of a floating pair of brake pads between which the brake disk passes. The wheel cylinder is attached to an arm-like holder and this is connected rigidly to an axle pin.

In addition, it is within the scope of the present invention that a slip coupling be provided between the wheel hub and the brake disk, this preventing lockup during the braking process.

BRIEF DESCRIPTION OF THE DRAWINGS

Further advantages, features, and details of the present invention are set out in the following description of a preferred embodiment that is described below in greater detail on the basis of the drawings appended hereto. These drawings show the following:

FIG. 1: A side view of a bicycle with the bicycle brake;

FIG. 2: Enlarged view of the master cylinder and the thimble insert of the bicycle brake in partial longitudinal cross-section;

FIG. 3: An arrangement of the wheel cylinders of the bicycle, partly sectioned;

FIG. 4: A side view of FIG. 3;

FIG. 5: The wheel cylinder of FIG. 3 in enlarged longitudinal cross-section;

FIG. 6: A plan view of another embodiment of two wheel cylinders on a vehicle tire;

FIG. 7: A side view of FIG. 6;

FIG. 8: A detail of an embodiment of the arrangement of the wheel cylinders of the bicycle shown as in FIG. 3;

FIGS. 9 and 11: Front views of other embodiments of a disk brake of a bicycle brake;

FIGS. 10 and 12: Partially sectioned side views of figures 9 and 11, respectively.

A bicycle brake 11 for a bicycle shown in FIG. 1 consists of a master cylinder 12 with a hand lever 13, a brake line that runs from the master cylinder 12, and a pair of wheel cylinders 17 on both sides of a wheel, indicated only in a simplified form at 19, in a bicycle which, for reasons of simplicity, is not shown in greater detail.

The wheel cylinders 17 are attached to a part of the forks 9 or the like at 21, by means of a caliper-like holder 20, and are connected by curved sections 15 of brake line and a T-piece 16 to the brake line 14. The master cylinder is mounted through a mounting clamp 23 and a cylinder housing adapter 24 on the handlebars at the point numbered 26.

The master cylinder 12 has a cylindrical pressure chamber 30; within this chamber a coil spring 32 rests at one end against a rear wall 29 of the chamber; at its other end, said spring 32 touches a disk piston 34. An annular groove 35 in the piston 34 accommodates an O-ring 36; at its end that is remote from the coil spring 32, the piston fits snugly against a plastic thimble 38 that is of elastic material. This thimble insert 38 is secured by a flange-like radial collar 40, between an annular shoulder 27 of the cylinder housing 25 and a clamping ring 28.

Within the interior space 39 of the elastic plastic thimble 38 there is a pushrod 44; a cam 46 that is an integral part of the hand lever 13, which is mounted on mounting means 47 so as to be able to pivot, abuts against the face end 45 of this pushrod 44. When the hand lever 13 is operated, the pushrod 44 and with it the disk piston 34 and the brake fluid Q in the pressure

chamber 30 is moved into the brake line 14 without any leakage because of the plastic thimble 38. As is shown in FIG. 5, the wheel cylinder 17 within the housing 18 is also fitted with a plastic thimble 38*a*, and the radial collar 40*a* of this thimble lies against an annular shoulder 27*a* of the housing 18, where it is held in position by means of a screw nipple 50. This nipple connects the sealed inner chamber 39*a* of the plastic thimble 38*a* to a brake line connector 31 for the line 15, through an angled drilling 51,52.

It can be seen that here, the brake fluid Q presses the disk piston 34_b against a hollow piston rod 54 when the master cylinder 12 is operated. This piston rod is configured with an inside conical surface and an annular shoulder 56 as a receiving sleeve for a slotted conical pin 58 with a radial, shoulder-like projecting clamp end 59. The conical pin 58 is the inserted portion of a brake shoe 60 which, because of the barbed-like pairing of the clamps 56/59, is installed so as to be replaceable.

The bridge-like brake shoe 60 shown in FIG. 6 is overlapped on both sides by side pieces 61 of the housing 18, and is provided with a braking surface 62 that is inclined relative to the longitudinal axis M of the cylinder.

In FIG. 6, two brake shoes 60 are located opposite each other with their braking surfaces 62 separated by an average distance b; they are secured in cylindrical holders 64 by a threaded sleeve 66 such that the interval between them can be altered. In this embodiment, a cross-arm 65 of the cylinder holder 64 ends at one side surface of the fork 9, shown here in cross section, to which the cylinder holder 64 is secured at 68.

This configuration makes it possible to pivot the cylinder holder 64 through an angle w of approximately 60° and then resecure it, which makes it much simpler to adjust the wheel cylinder 17.

Because of the design shown in FIG. 8 the wheel cylinders 17 on the wheel 19 can be adjusted, without any problem, by at least 50 mm and by a maximum of 70 mm (dimensions e, e_1). Each is mounted in an eccentric disk 82 that is installed so as to be rotatably adjustable in bearings 80 on the holder 20; the position of this eccentric disk can be fixed by operating a lock 81.

As has been discussed, the whole of the brake system described above is leak-free since the brake fluid even in the wheel cylinders cannot escape. It fills the interior space 39*a* of the plastic thimble 38*a*, the face surface 37*a* of which is forced in the direction x by the brake fluid Q. When this occurs, as is shown in FIG. 5, the disk piston 34_b moves to the left and forces the brake shoe 60 out. When the pressure of the brake fluid drops, the brake shoe 60 is then retracted by the coil spring 32*a* in the same manner as the disk piston 34 of the bicycle brake 11 in FIG. 2.

The leak-free system that has been described can, of course, be used for a brake disk 70 arranged as shown in FIGS. 9 and 10 on the hub 72 of a wheel axle 73. The brake disk 74 passes through a gap 76 between the above described movable brake pad 78 and a coaxially opposite fixed brake pad 78_a. The movable brake pad 78 is in this instance connected to an axial pin 77 of the disk piston 34*d* that protrudes from the housing 18_a. The latter encloses a plastic thimble 38*b* in the manner already described, and this thimble 38*b* is held in position by a screw 50_a to which the brake line 14, 15 is connected.

What is involved here is a so-called floating saddle brake 78, 78_a; during the braking process the coaxial brake pads 78, 78_a are drawn together in the manner of a caliper and thus restrain the brake disk 74. The housing 18*a* is secured by means of a holding arm 71, and a bolt mounting 75.

In the embodiment shown in FIGS. 11 and 12 the holding arm 71*a* is shown without a bolt mounting and accommodates the housing 18_a in a frame 84 at a distance i of 65 mm from the shaft A. This holding arm 71*a* entails the advantage of being easily adjustable.

In addition, it is also foreseen that there be a sliding coupling between the brake disk 74 and the hub 72, to prevent the system from locking up.

What is claimed is:

1. A bicycle brake system which comprises: at least one master cylinder; a hand lever connected to said master cylinder; at least one wheel cylinder connected to said master cylinder; a hydraulic brake line connecting said wheel cylinder to said master cylinder; a space of variable volume opening out from both ends of said brake line adjacent the master cylinder and the wheel cylinder, respectively; a piston and spring means supported thereby operatively associated with the variable volume space of the master cylinder, with said piston in sliding engagement with the master cylinder, wherein said piston is configured as a disk piston with an annular groove for an O-ring; an O-ring in said annular groove in sliding engagement with said master cylinder; a push rod operated by said hand lever; an elastic plastic thimble having an interior space and secured in the master cylinder and closed at one end by a closed face, wherein the interior space accommodates said push rod and wherein said closed face abuts said piston and wherein said piston and push rod are on opposite sides of said closed face; whereby said hand lever, push rod, thimble, piston and spring means cooperate to reduce the volume of the variable volume space of the master cylinder; an elastic plastic thimble secured to the space of variable volume of the wheel cylinder, said wheel cylinder thimble having an interior space connected to the brake line and closed at one end by a closed face, brake pads operatively associated with said closed face, whereby the closed face applies a braking force on the brake pads.

2. A bicycle brake as defined in claim 1 wherein the thimbles of the master cylinder and the wheel cylinder are formed as hollow cylinders with a radial collar at the open end of the cylinders.

3. A bicycle brake as defined in claim 1 including a cylinder housing of the master cylinder, wherein the thimble of the master cylinder is secured with its radial collar between an annular shoulder of the cylinder housing on the one side and a clamping ring on the other.

4. A bicycle brake as defined in claim 3 wherein said spring means is a coil spring and wherein said coil spring extends between the piston and said shoulder-like part of the cylinder housing.

5. A bicycle brake as defined in claim 1 including a cylinder housing of the wheel cylinder, wherein the thimble of the wheel cylinder is secured with its radial collar between an annular shoulder of the cylinder housing on the one side and a screw nipple on the other.

6. A bicycle brake as defined in claim 1 including a hollow piston rod and coil spring means supported thereby operatively associated with the variable volume space of the wheel cylinder, wherein the coil spring means of the wheel cylinder surrounds said hollow

piston rod, said hollow piston rod having an inside conical surface receiving a conical pin of the brake pad.

7. A bicycle brake as defined in claim 1 including a bicycle frame wherein the wheel cylinder is axially adjustable in a cylinder holder that is radial thereto, wherein the cylinder holder is pivotally connected to the bicycle frame.

8. A bicycle brake as defined in claim 7 wherein the angle of pivot (w) is approximately 60° in an approximately vertical plane.

9. A bicycle brake as defined in claim 1 wherein the wheel cylinder is supported in a rotatable eccentric disk and its axis is parallel to the axis of said disk.

10. A bicycle brake as defined in claim 9 wherein the eccentric disk is supported so as to be fixable in a U-shaped holder and extends approximately parallel to the adjacent wheel.

11. A bicycle brake as defined in claim 1 wherein the thimble of the wheel cylinder is associated with a brake pad of a disk brake, said brake pad acting at right angles to the plane of the disk close to the edge of said disk.

12. A bicycle brake as defined in claim 11 wherein the brake pad is part of a floating pair of brake pads between which the brake disk passes.

13. A bicycle brake as defined in claim 11 wherein the wheel cylinder is attached to an arm-like holder and this is connected rigidly to an axle pin.

14. A bicycle brake as defined in claim 11 including a wheel hub, wherein between the wheel hub and the brake disk there is a slip coupling.

* * * * *

United States Patent [19]

Chang

[11] Patent Number: 4,633,726

[45] Date of Patent: Jan. 6, 1987

[54] EXTERNAL HYDRAULIC DRIVING SYSTEM FOR MOTORCYCLE BRAKE, CLUTCH AND GEAR SHIFT

[76] Inventor: Kuo-Chou Chang, P.O. Box 10160, Taipei, Taiwan

[21] Appl. No.: 654,842

[22] Filed: Sep. 25, 1984

[51] Int. Cl.⁴ G05G 9/00

[52] U.S. Cl. .... 74/473 R; 74/488; 74/89.17; 74/89.21; 60/567; 60/571; 60/594; 180/336

[58] Field of Search .... 60/567, 571, 594; 180/336; 74/488, 489, 473 R, 89.17, 89.21

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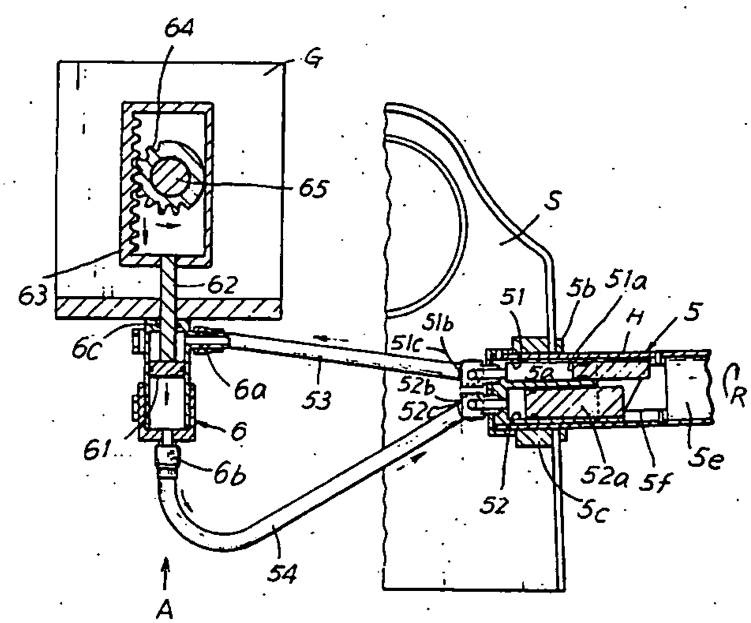
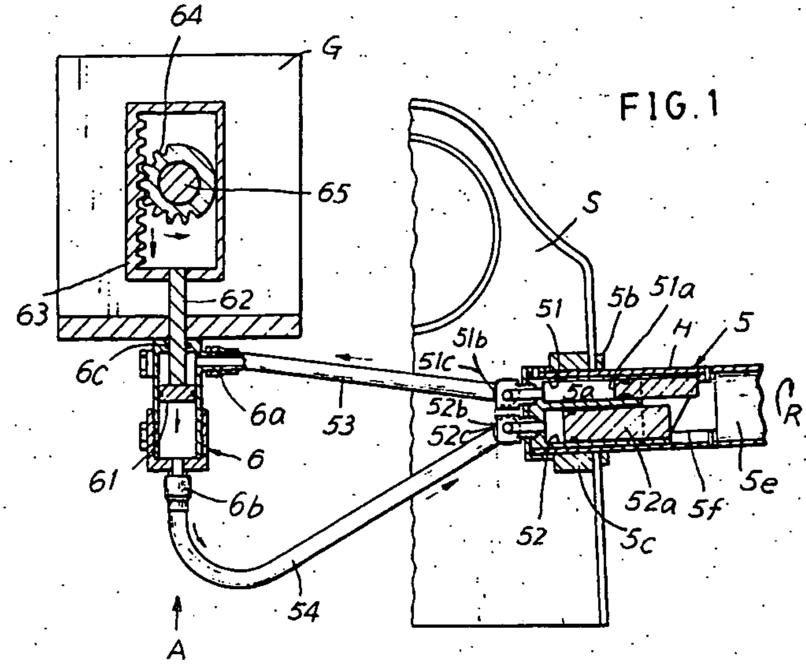
Primary Examiner—Abraham Hershkovitz

[57] ABSTRACT

A hydraulic driving system for motorcycle gear shift includes a primary cylinder combination, a secondary cylinder and a set of delivery conduits for handling hydraulic fluid connected therebetween, in which two primary cylinders with different diameters are oppositely formed in a hollow portion of a motorcycle handle and the two primary cylinders are respectively fluidically communicated with the secondary cylinder to reciprocatively and linearly move a gear rack and to drive the shaft of the gear shift by rotating a twist bar, formed on the handle, having an inclined-plane tongue alternatively actuating the two primary cylinders in the handle.

2 Claims, 4 Drawing Figures

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G
65
S
63
62
51
5b
51a
H
5
51b
51c
5a
R
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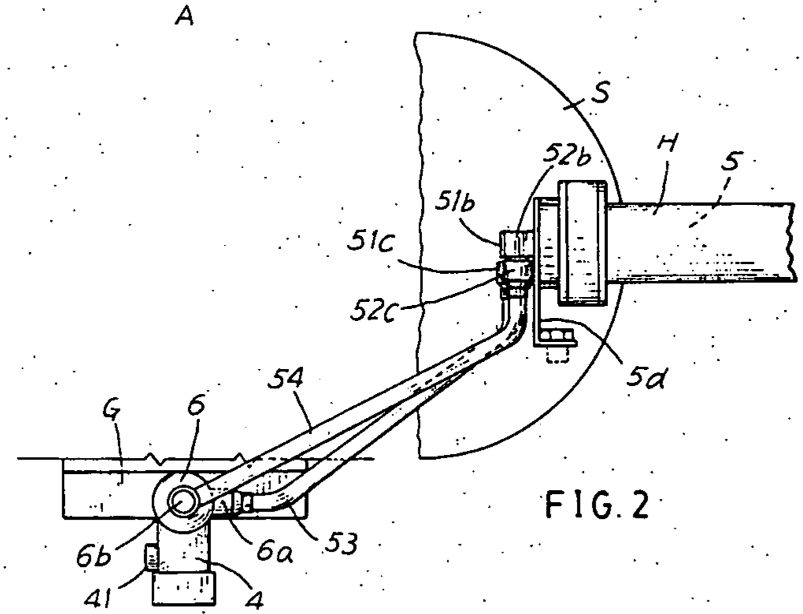
53
52b
52c
6
61
6b
52a
5f
5e
52
5c
54
A

FIG. 1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51c
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5d
54
G
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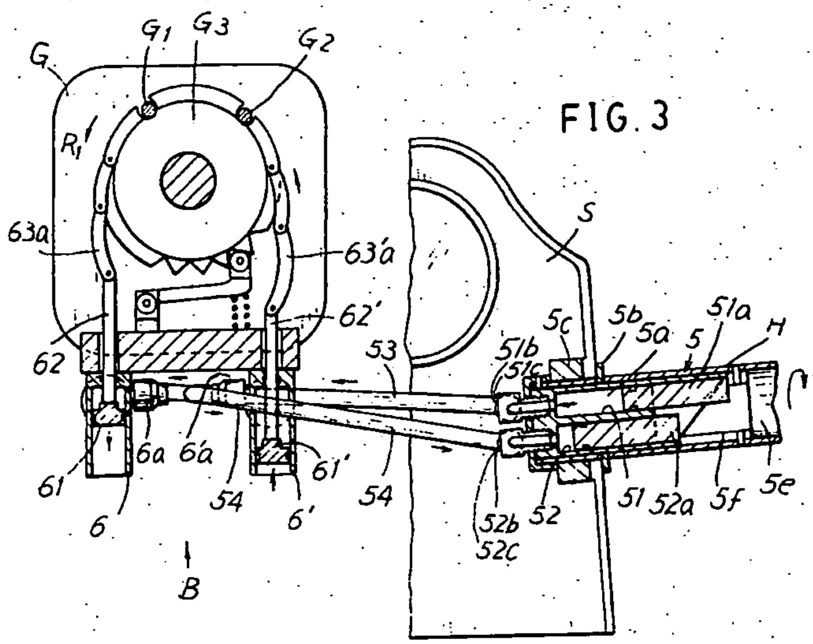
6b
6a
53
41
4

FIG. 2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G1
G3
G2
R1
63a
63'a
62'
62
53
5c
5b
5a
51a
5
H
51b
51c
61
6a
6'a
54
61'
6
6'
54
52b
52c
52
51
52a
5f
5e
B
S

FIG. 3

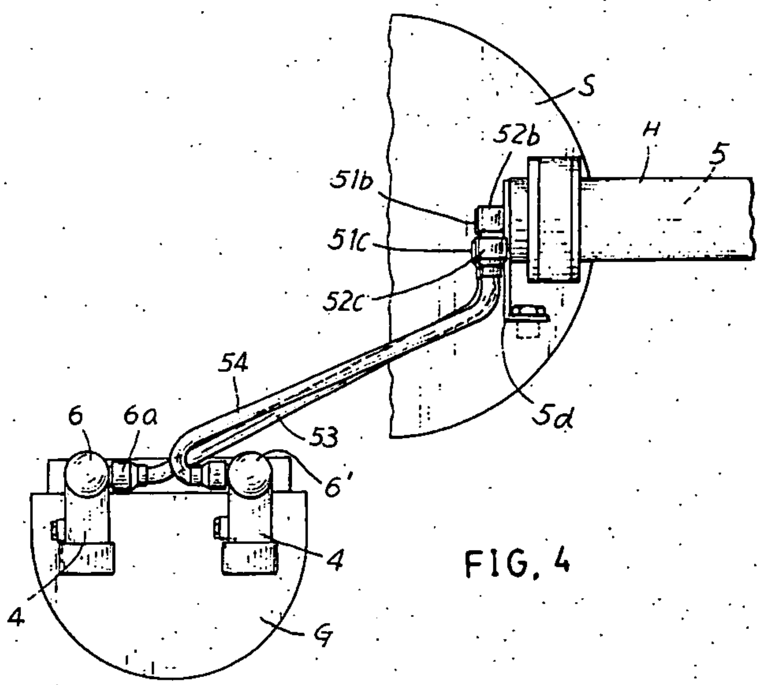
S
52b
H
5
51b
51c
52c
54
6
6a
53
5d
6'
4
4
4
G

FIG. 4

EXTERNAL HYDRAULIC DRIVING SYSTEM FOR MOTORCYCLE BRAKE, CLUTCH AND GEAR SHIFT

BACKGROUND OF THE INVENTION

Conventional motorcycles utilize a wire rope jacketed into a plastic hose to drive the brake, clutch or gear shift, which, however, will be easily broken after long time service to lose its original functions and may possibly cause traffic accidents. The wire ropes shuttled within the plastic hose during their operation may cause friction loss as the wire abrades by the hose especially in the bending hose portions to thereby require greater force for operating the brake, clutch or grear shift. Moreover, when pulling the wire ropes with a greater force, the wire may be broken to cause an accident.

The present inventor has found the defects of conventional means used in motorcycle brake, clutch or gear shift. An improvement over the conventional means has been made by the present inventor in view of the following specification accompanying the drawings.

BRIEF SUMMARY OF THE INVENTION

The object of the present invention is to provide a hydraulic driving system for motorcycle gear shift, which comprises a primary cylinder combination, a secondary cylinder and a set of delivery conduits for handling hydraulic fluid connected therebetween, and in which two primary cylinders with different diameters are oppositely formed in a hollow portion of a motorcycle handle and the two primary cylinders are respectively fluidically communicated with the secondary cylinder to reciprocatively and linearly move a gear rack and to drive the shaft of the gear shaft by rotating a twist bar formed in the handle having an inclined-plane tongue alternatively actuating the two primary cylinders therein.

Another object of the invention is to provide a hydraulic driving system for motorcycle gear shift, which comprises a primary cylinder combination having two primary cylinders mounted on a motorcycle handle; and a secondary cylinder composition having two secondary cylinders respectively and fluidically communicated with the two primary cylinders and operatively actuating the motorcycle gear shift.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view of the present invention.

FIG. 2 is an illustration of the present invention taken from direction A of FIG. 1.

FIG. 3 is a sectional drawing of another preferred embodiment of the present invention.

FIG. 4 is an illustration of the present invention taken from direction B of FIG. 3.

DETAILED DESCRIPTION

As shown in FIG. 1 and FIG. 2, the present invention comprises a primary cylinder combination 5 and a secondary cylinder 6.

Primary cylinder combination 5 is formed as a cylindrical body inserted into a hollow portion of a handle H and is fixed onto a shield S by a fixing ring 5*b*, bushing 5*c* and fixing bracket 5*d*. In the cylindrical body of the primary cylinder combination 5, two primary cylinders 51, 52 with different diameters are provided. Primary cylinders 51 having a smaller diameter is provided with a piston 51*a* therein and filled with hydraulic fluid. An oil ring 51*a* is provided in the primary cylinder to prevent oil leakage. Cylinder 51 is then connected, by a connector 51*b*, a coupling 51*c* and a first delivery conduit 53, to an upper connector 6*a* positioned on the top portion of the secondary cylinder 6 as FIG. 1 shows. The secondary cylinder 6 is then connected, by a lower connector 6*b* formed on the lower portion of cylinder 6, to a second delivery conduit 54, another coupling 52*c* and another connector 52*b*, to primary cylinder 52 having a larger diameter. Naturally, another oil ring is provided to prevent oil leakage from the secondary cylinder. A twist bar 5*e* is rotatively provided within handle H. An inclined-plane tongue 5*f* is extended from bar 5*e* to alternatively push or retract two pistons 51*a*, 52*a*.

Secondary cylinder 6 comprises a piston 61 and a piston rod 62 which is connected with a gear rack 63 for engaging a driving gear 64 of a shaft 65 of the gear shift G. An oil ring 6*c* is provided thereon for preventing oil leakage.

The embodiment may be applied in gear shift of the type used in scooter 90 cc and 125 cc. As shown in FIG. 1, the twist bar 5*e* can be rotated in direction R and the inclined-plane tongue 5*f* is also rotated to push the pistion 51*a* of the cylinder having smaller diameter 51 to boost hydraulic fluid 5*a* through the first conduit 53 into the upper portion of secondary cylinder 6 so as to push downwards the piston 61 and rod 62 to drive the shaft 65 of the gear shift G. The fluid under piston 61 will be boosted though second conduit 54 to retract piston 52*a* of the cylinder having a larger diameter 52 for the next operation. As piston rod 62 occupies a substantial volume in the upper portion of secondary cylinder 6, the fluid volume above piston 61 and the fluid volume thereunder will be different. In order to keep an identical reciprocative stroke for two pistons 51*a*, 52*a* having different diameters, the ratio of cross-sectional areas of the two pistons must be designed to obtain a smooth operation of the whole system in that a maximum stroke of each piston 51*a* or 52*a* should be equivalent.

Another preferred embodiment of the present invention is shown in FIG. 3 and FIG. 4, which comprises a primary cylinder combination 5 and a secondary cylinder combination 6. Such an embodiment may be used in a scooter 150 cc. The primary cylinder combination 5 also comprises two primary cylinders 51, 52 as aforementioned, except that the diameter of each piston is equal. The description for the numerals of said primary cylinder combination as shown in FIG. 3 is thereby omitted.

Secondary cylinder combination 6 comprises two secondary cylinders 6, 6' each having the same diameter. Cylinder 6 includes a piston 61 and a piston rod 62 and the other cylinder 6' includes a piston 61' and a piston rod 62'. Two arc-link chains 63*a*, 63*a*' are respectively connected to two rods 62, 62'. Two chains 63*a*, 63'*a* respectively engage on both sides of pulley G3 of the gear shift G by two cylindrical engaging bars G1, G2.

When rotating the twist bar 5*e*, the tongue 5*f* will push the piston 51*a* the primary cylinder 51 to boost hydraulic fluid through first conduit 53 into secondary cylinder 6 to lower piston 61 and rotate the pulley G3 in the direction R1 for gear-shifting purpose. The chain 63'*a* and rod 62' on the right side of pulley G3 will be moved upwards to raise piston 61' to return the fluid in

cylinder 6' through second conduit 54 into primary cylinder 52 to retract piston 52a therein for the next operation.

The present invention has the following advantages over any conventional art:

1. All cylinders are installed outside the brake, clutch or gear-shift so that any accidental oil leakage will not influence their operation. It will not obstruct the construction space of a vehicle. 2. The conventional wire ropes are eliminated so that the wire-broken defect and the friction caused by wire ropes will be inproved. The present invention will be operated in a smoother manner.

I claim:

1. An external driving system for a motorcycle gear shift comprising:

a primary cylinder combination having two primary cylinders mounted on a handle of a motorcycle; and

a secondary cylinder fluidically communicated with said primary cylinder combination by two delivery conduits, and including a piston in said secondary cylinder, a piston rod connected with a gear rack which engages with a driving gear of the motorcycle gear shift; the improvement which comprises:

said primary cylinder combination including a first primary cylinder having a small diameter and fluidically communicated with an upper connector positioned above said piston of said secondary cylinder by a first delivery conduit of hydraulic fluid, a piston disposed in said primary cylinder, a second primary cylinder having a larger diameter than said first primary cylinder and fluidically communicated with a lower connector positioned under said piston of said secondary cylinder, a piston disposed in said second primary cylinder, the motorcycle handle having a hollow portion, both said primary cylinders inserted into the hollow portion of the motorcycle handle and both pistons of said primary cylinders alternatively pushed or retracted by an inclined-plane tongue of a twist bar formed in said handle, whereby upon the twisting of said twist bar, said piston in said first primary cylinder will be pushed to force the hydraulic fluid through said first delivery conduit to lower said piston in said secondary cylinder to actuate said gear shift and force the fluid under said piston of said secondary cylinder through said secondary delivery conduit for retracting said piston in said second primary cylinder.

2. An external driving system for motorcycle gear shift comprising:

a primary cylinder combination having two primary cylinders mounted on a motorcycle handle, the handle having a hollow portion; and

a secondary cylinder combination having two secondary cylinders respectively and fluidically communicated with two said primary cylinders, and operatively actuating the motorcycle gear shift;

the improvement which comprises:

said primary cylinder combination including two primary cylinders having the same diameter, a seaprate piston in each of said two primary cylinders alternatively pushed or retracted by an inclined-plane tongue of a twist bar formed in said handle, the two primary cylinders being inserted into the hollow portion of the motorcycle handle;

said secondary cylinder combination including two secondary cylinders having the same diameter and each fluidically communicated with each said primary cylinder,

each said secondary cylinder including a piston and a piston rod connected with an arc-link chain so that two arc-link chains of said two secondary cylinders respectively engage on both sides of a pulley of the gear shift, twisting of the twist bar in one direction causing the piston of one of said two primary cylinders to force hydraulic fluid to act on the piston of one of the secondary cylinders to thereby rotate the pulley to actuate said gear shift and have the piston of the other of the second cylinders force fluid to act on the piston of the other of said two primary cylinders for causing retraction of same.

* * * * *

US005832782A

United States Patent [19]

Kawakami

[11] **Patent Number: 5,832,782**

[45] **Date of Patent: Nov. 10, 1998**

[54] **BRAKE AND SHIFTING DEVICE**

[75] Inventor: **Tatsuya Kawakami**, Sakai, Japan

[73] Assignee: **Shimano, Inc.**, Osaka, Japan

[21] Appl. No.: **909,772**

[22] Filed: **Aug. 12, 1997**

Related U.S. Application Data

[63] Continuation of Ser. No. 652,142, May 17, 1996, abandoned.

[30] **Foreign Application Priority Data**

May 26, 1995 [JP] Japan 7-152450

[51] **Int. Cl.**[6] **B60K 41/26**; B62K 23/06; B62M 25/04

[52] **U.S. Cl.** .... **74/473.13**; 74/489; 74/502.2; 116/28.1; 192/4 R

[58] **Field of Search** .... 74/475, 489, 502.2, 74/473.13, 473.14; 192/4 R; 116/28.1

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Primary Examiner—Allan D. Herrmann
Attorney, Agent, or Firm—James A. Deland

[57] **ABSTRACT**

A combined brake and shifting control device includes a brake lever housing, a brake lever pivotably coupled to the brake lever housing, a speed change housing, a ratchet mechanism disposed within the speed change housing, one or more shift levers coupled to the ratchet mechanism so that the ratchet mechanism rotates in response to movement of the shift lever(s), and a shaft coupled to the ratchet mechanism for rotation therewith. The speed change housing is attached to a brake lever housing so that the shaft extends outside the speed change housing and into the brake lever housing.

21 Claims, 17 Drawing Sheets

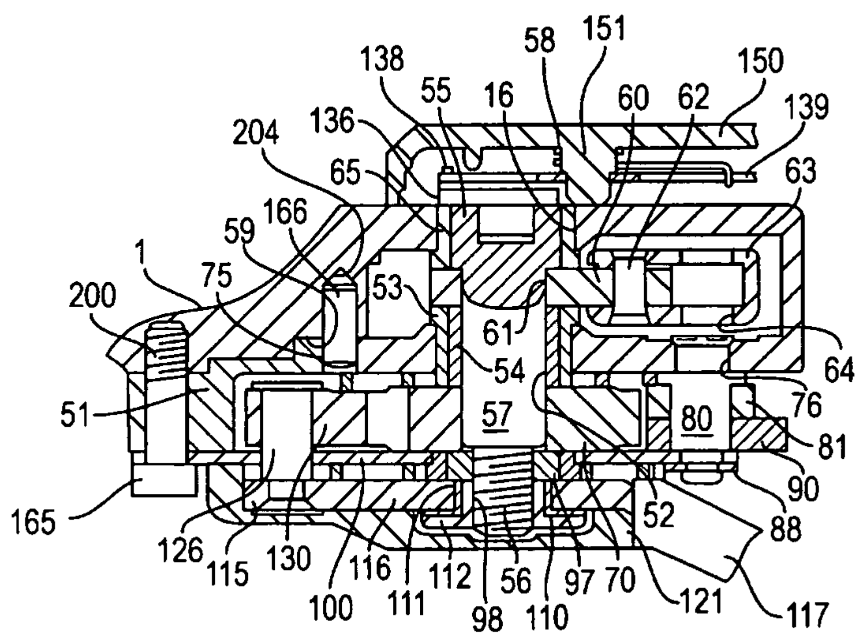


FIG. 1

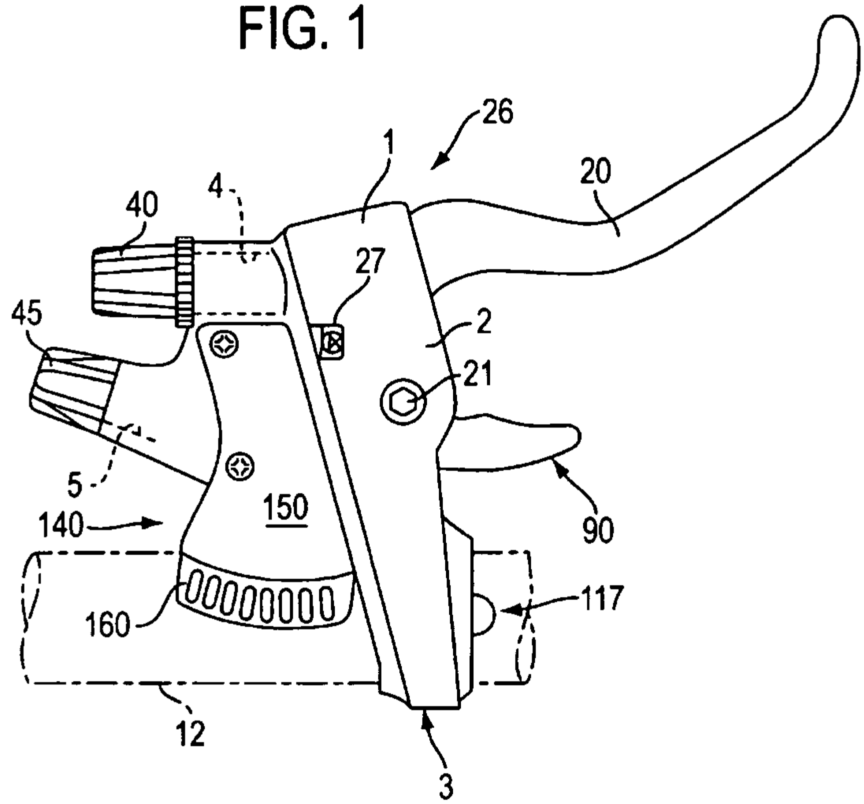

26
1
20
40
4
27
45
2
21
5
90
140
150
160
117
12
3

FIG. 2

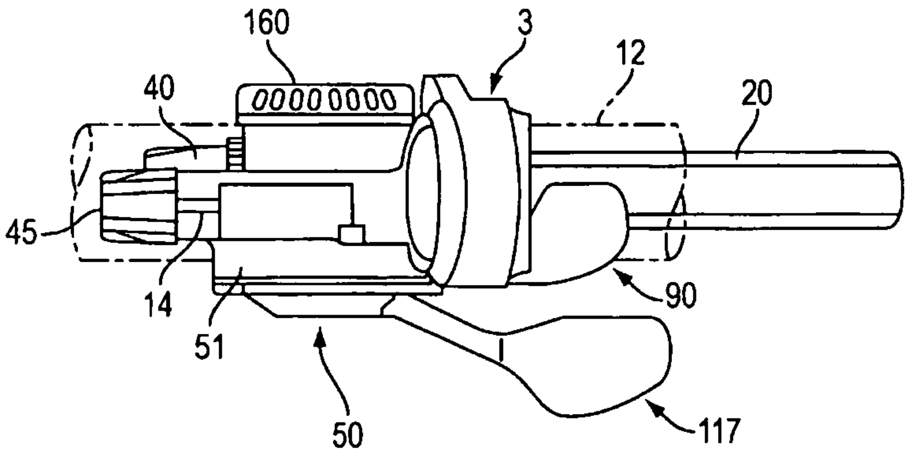

160
3
12
20
40
45
14
51
90
50
117

FIG. 3

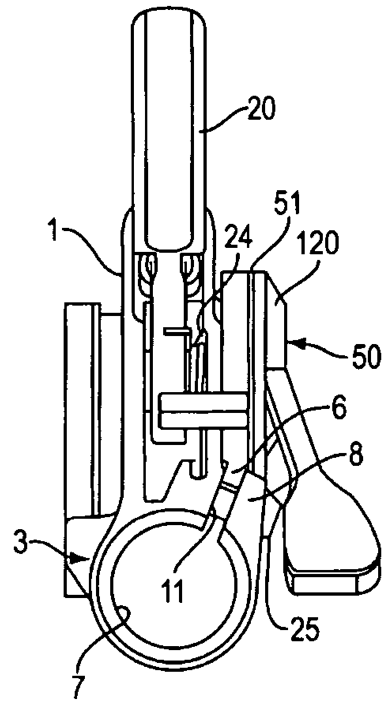
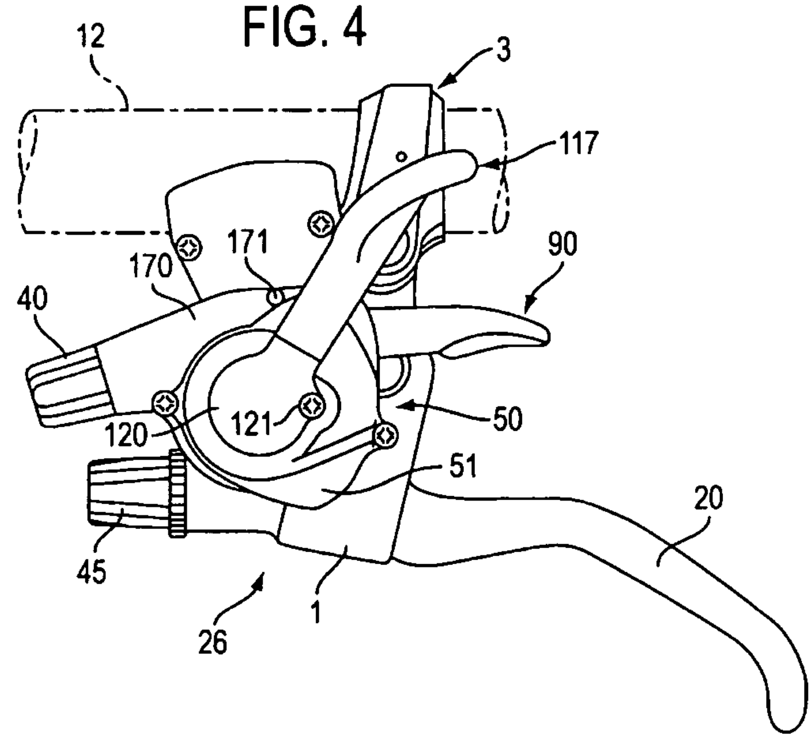

20
1
24
51
120
50
6
8
3
11
25
7

FIG. 4


12
3
117
90
171
170
40
50
120
121
51
20
45
1
26

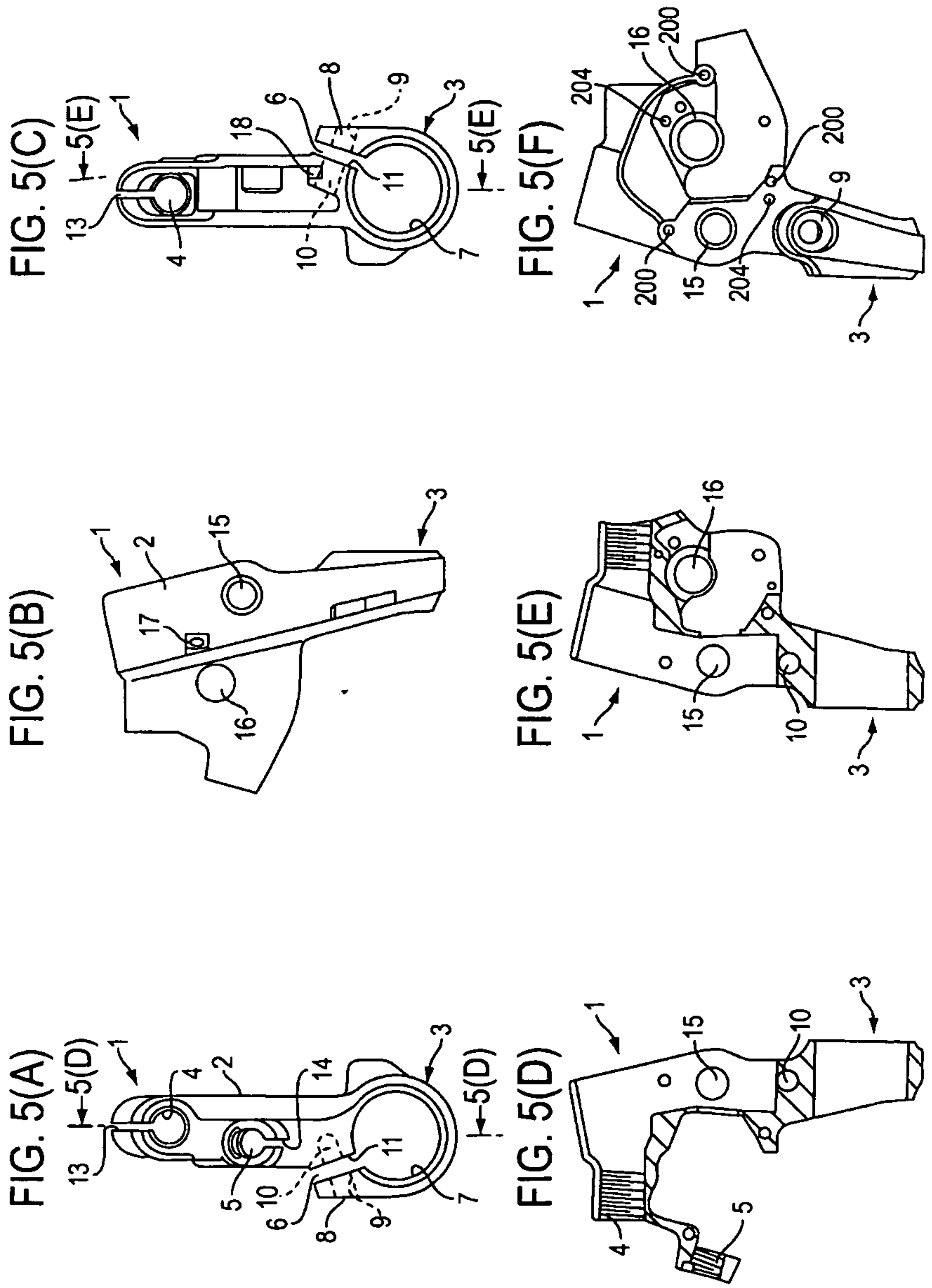


FIG. 5(A)

FIG. 5(B)

FIG. 5(C)

FIG. 5(D)

FIG. 5(E)

FIG. 5(F)

FIG. 6

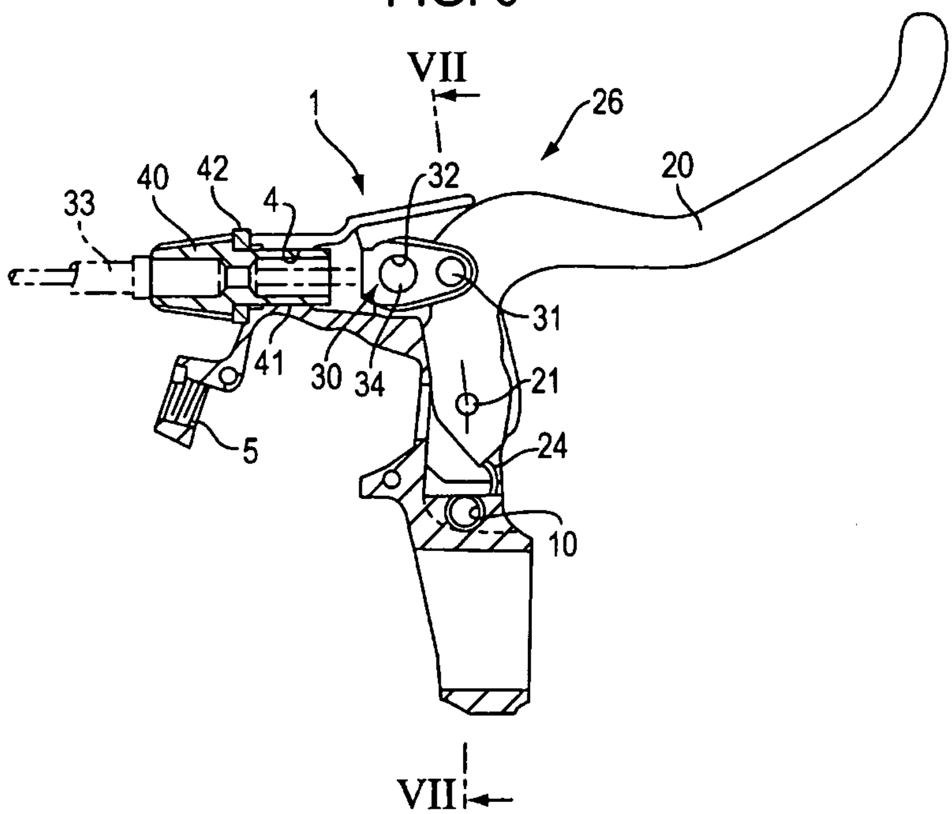

VII
1
26
32
20
42
40
4
33
31
41
30
34
21
5
24
10
VII

FIG. 7

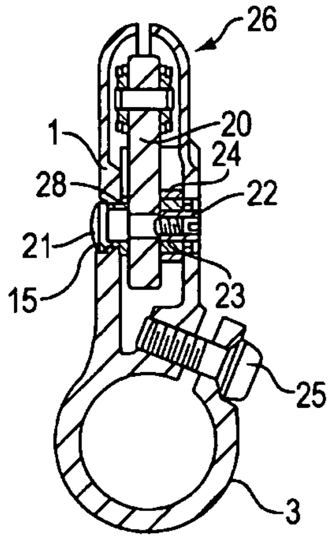

26
20
1
24
28
22
21
15
23
25
3

FIG. 8

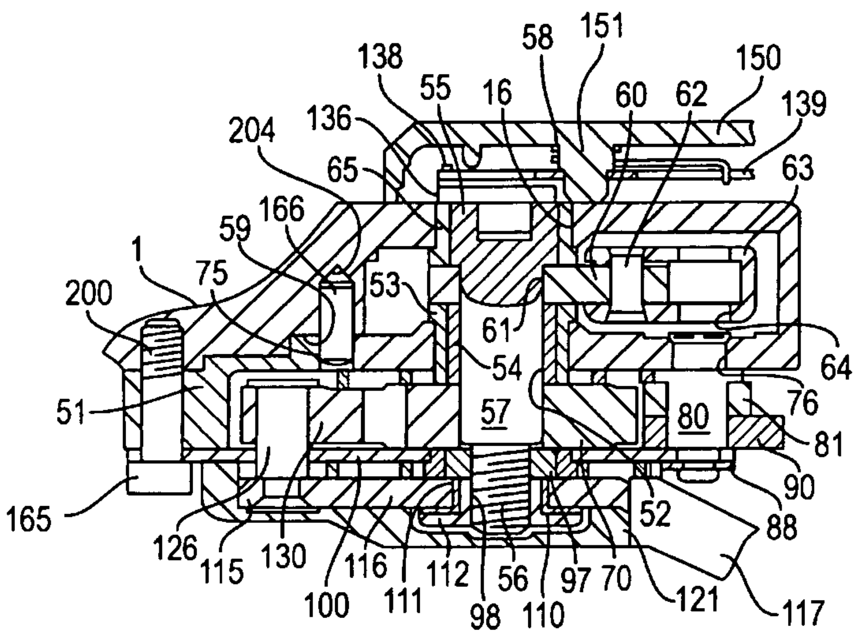


FIG. 10(A)

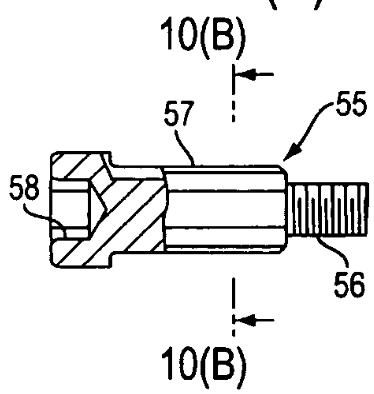


FIG. 10(B)

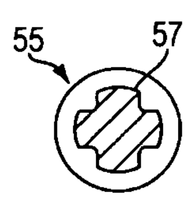


FIG. 9(C)

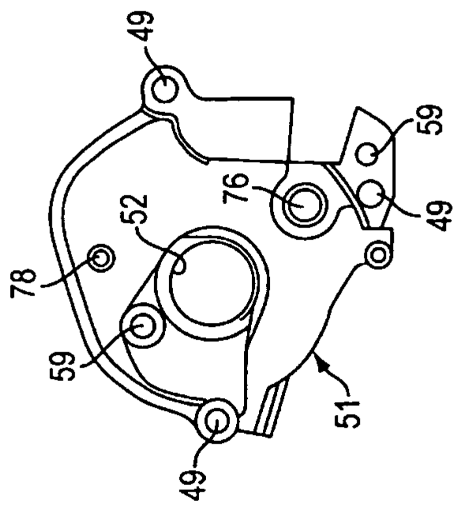


FIG. 9(B)

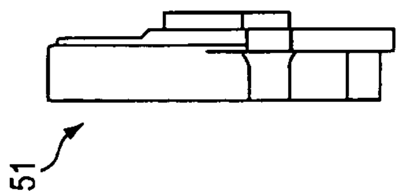


FIG. 9(D)

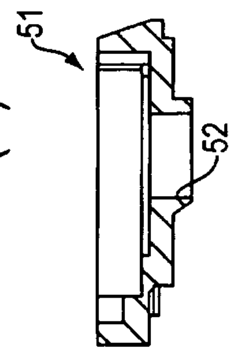


FIG. 9(A)

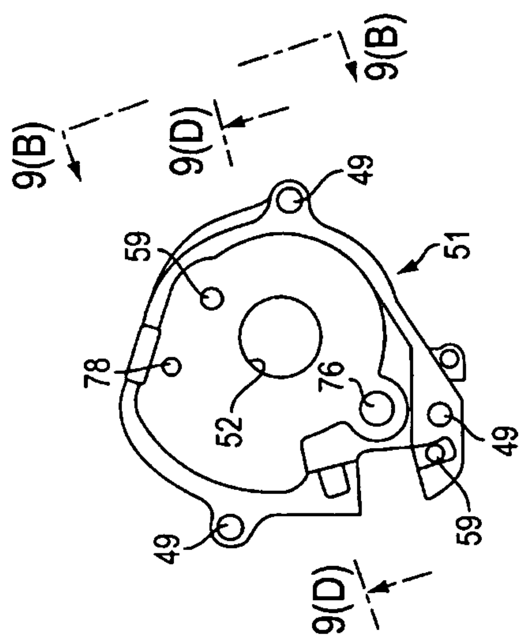


FIG. 11(A)

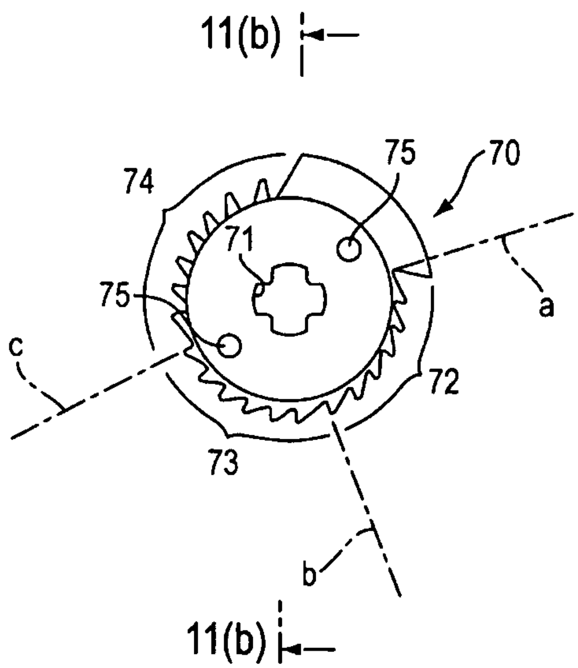


FIG. 11(B)

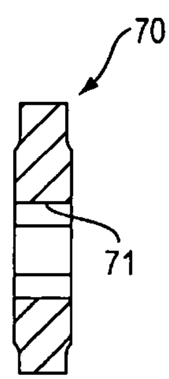


FIG. 12

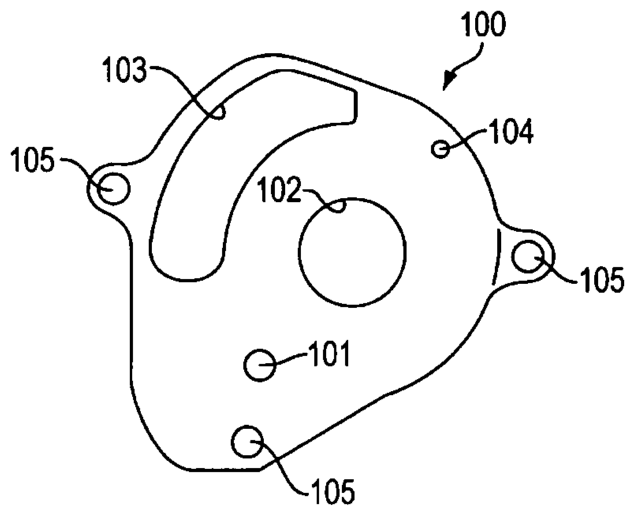


FIG. 16(A)

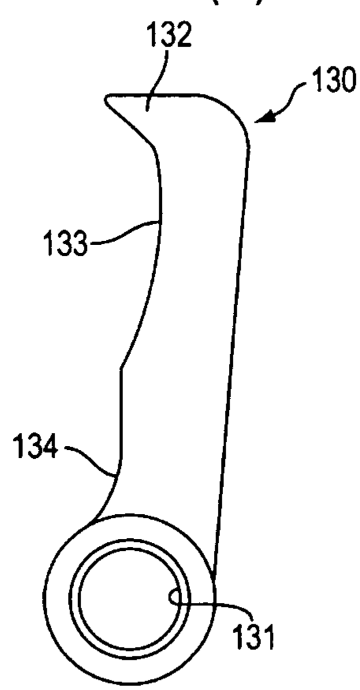


FIG. 16(B)

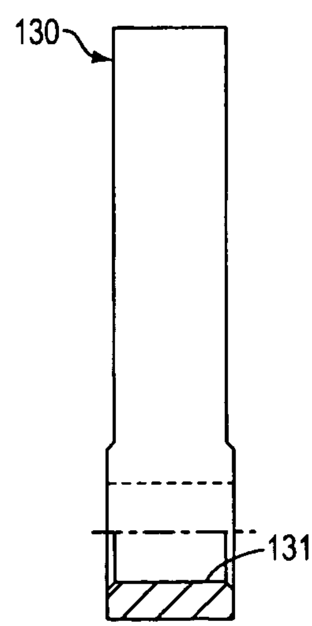


FIG. 13(A)

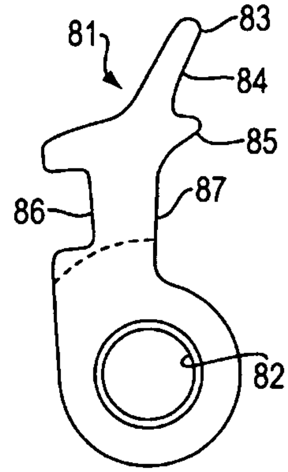


FIG. 13(B)

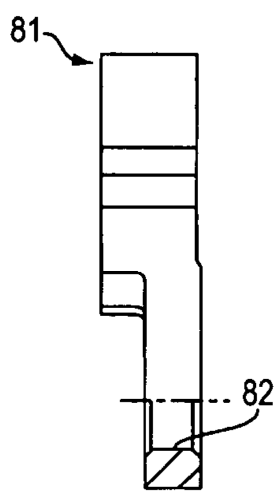


FIG. 14(A)

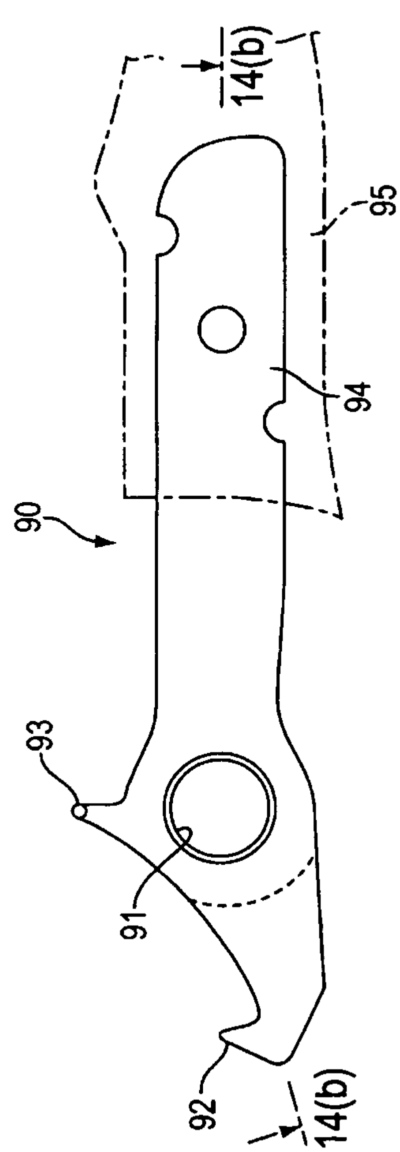
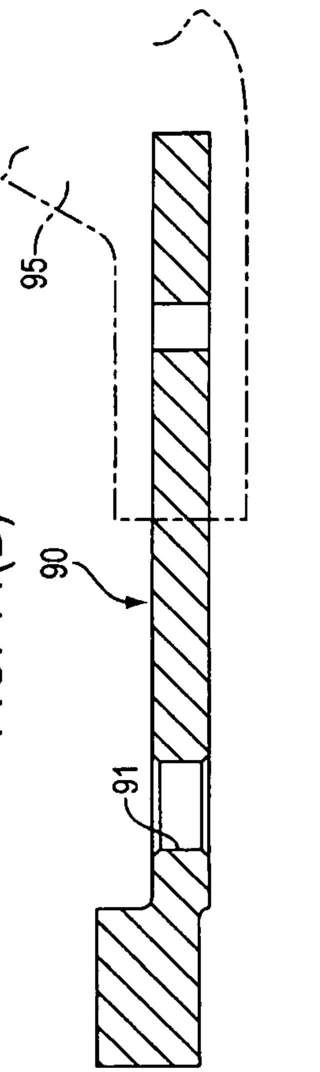


FIG. 14(B)



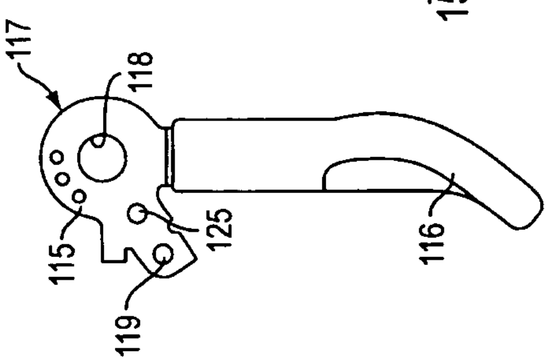


FIG. 15(A)

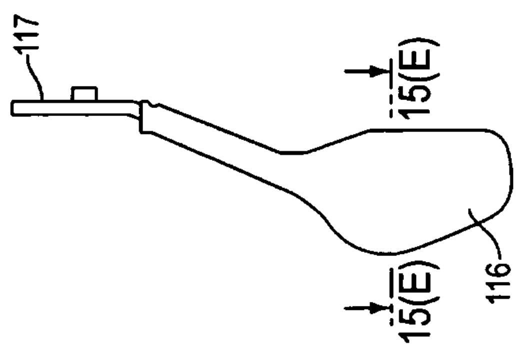


FIG. 15(B)

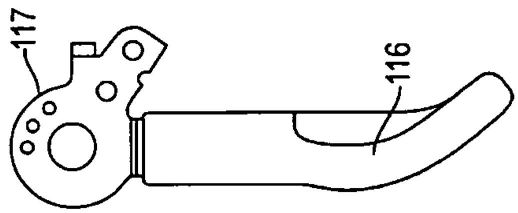


FIG. 15(C)

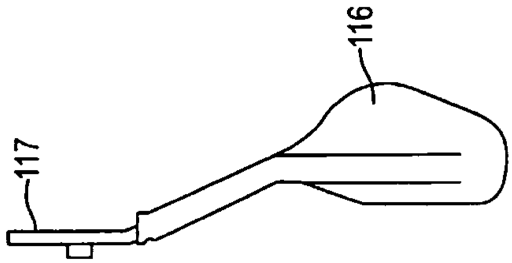


FIG. 15(D)

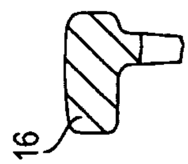


FIG. 15(E)

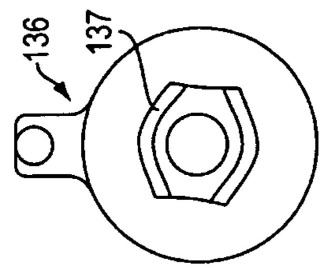


FIG. 17(C)

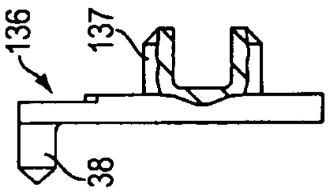


FIG. 17(B)

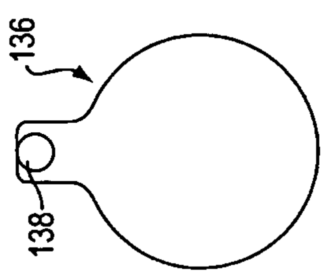


FIG. 17(A)

FIG. 18(A)

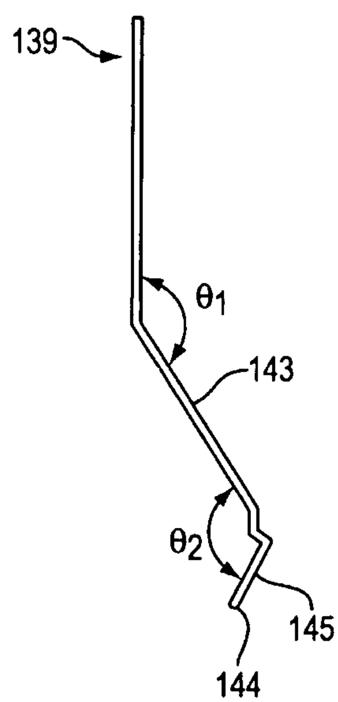
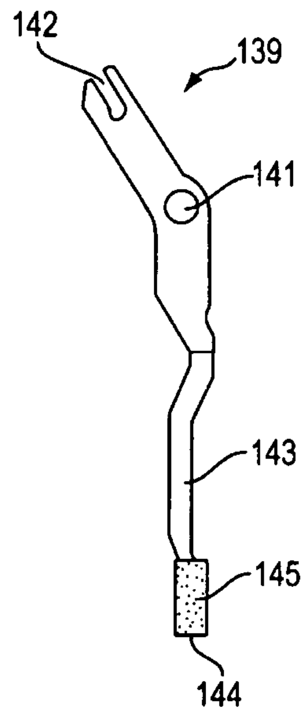


FIG. 18(B)



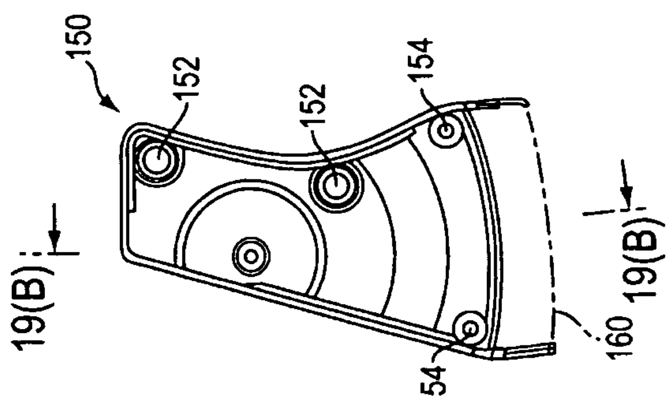


FIG. 19(A)

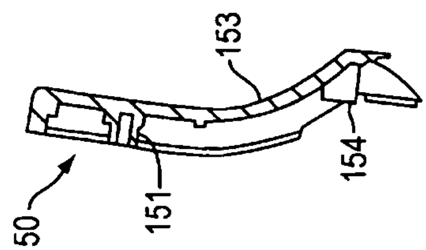


FIG. 19(B)

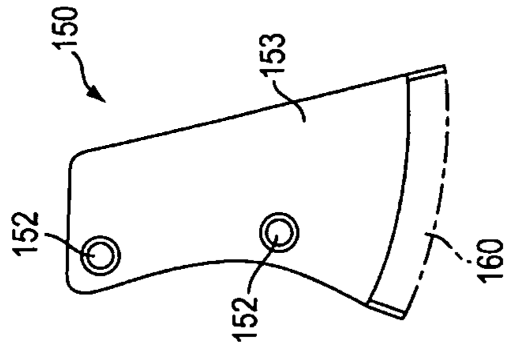


FIG. 19(C)

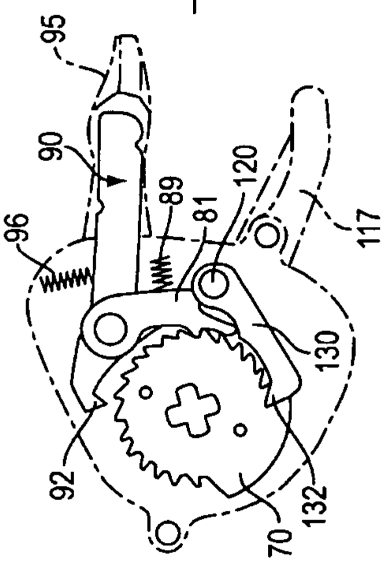


FIG. 20(A)

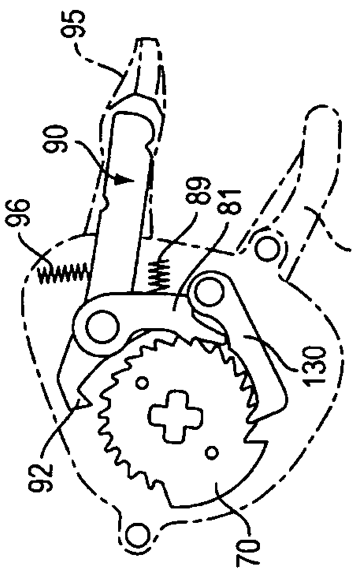


FIG. 20(B)

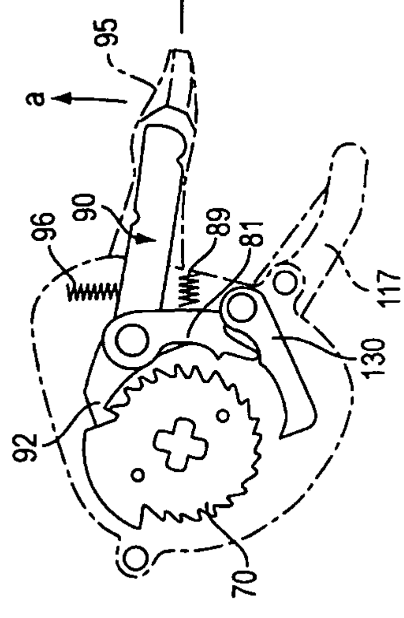


FIG. 20(C)

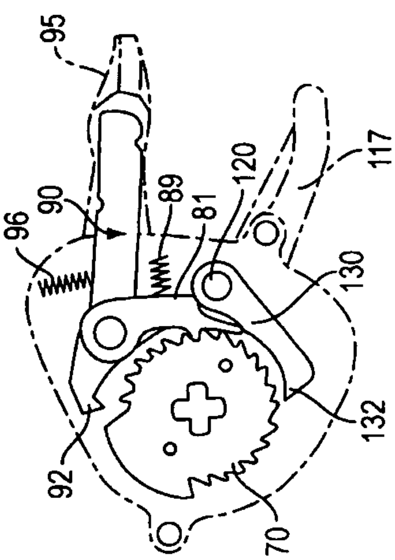


FIG. 20(D)

FIG. 21

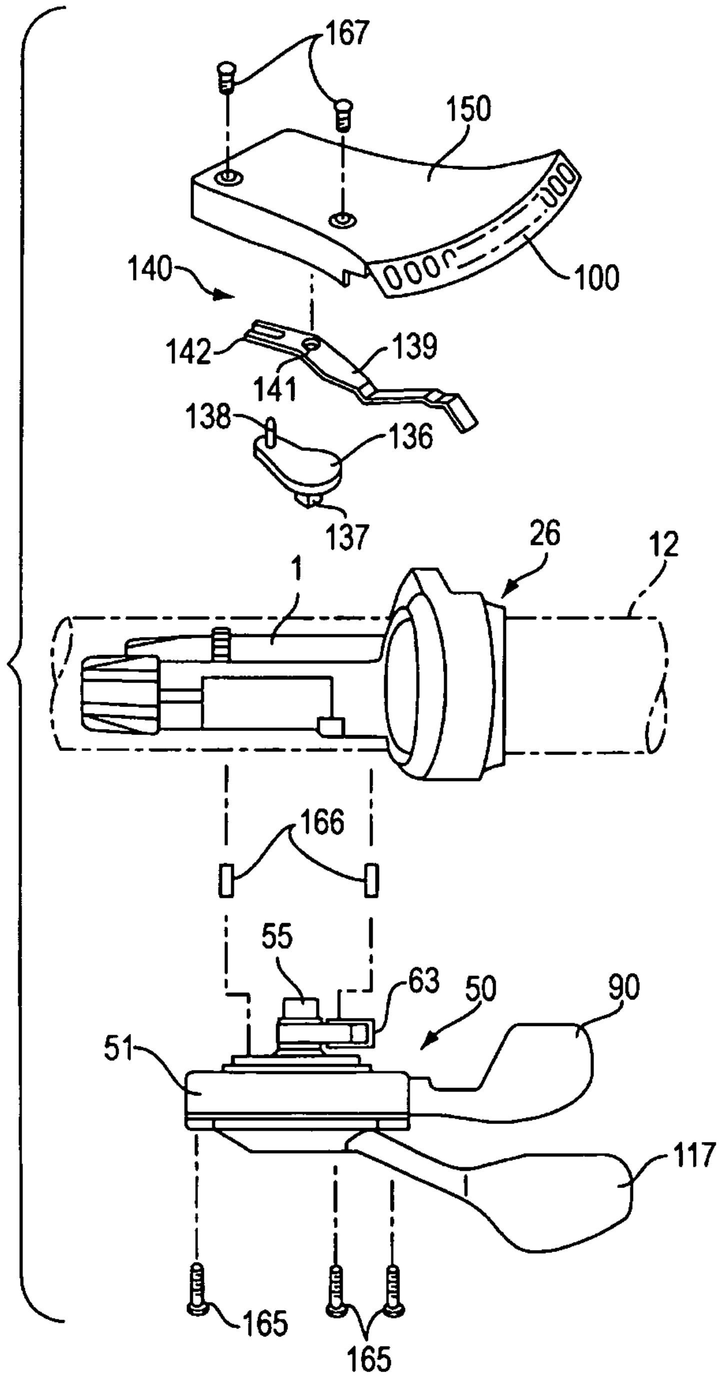
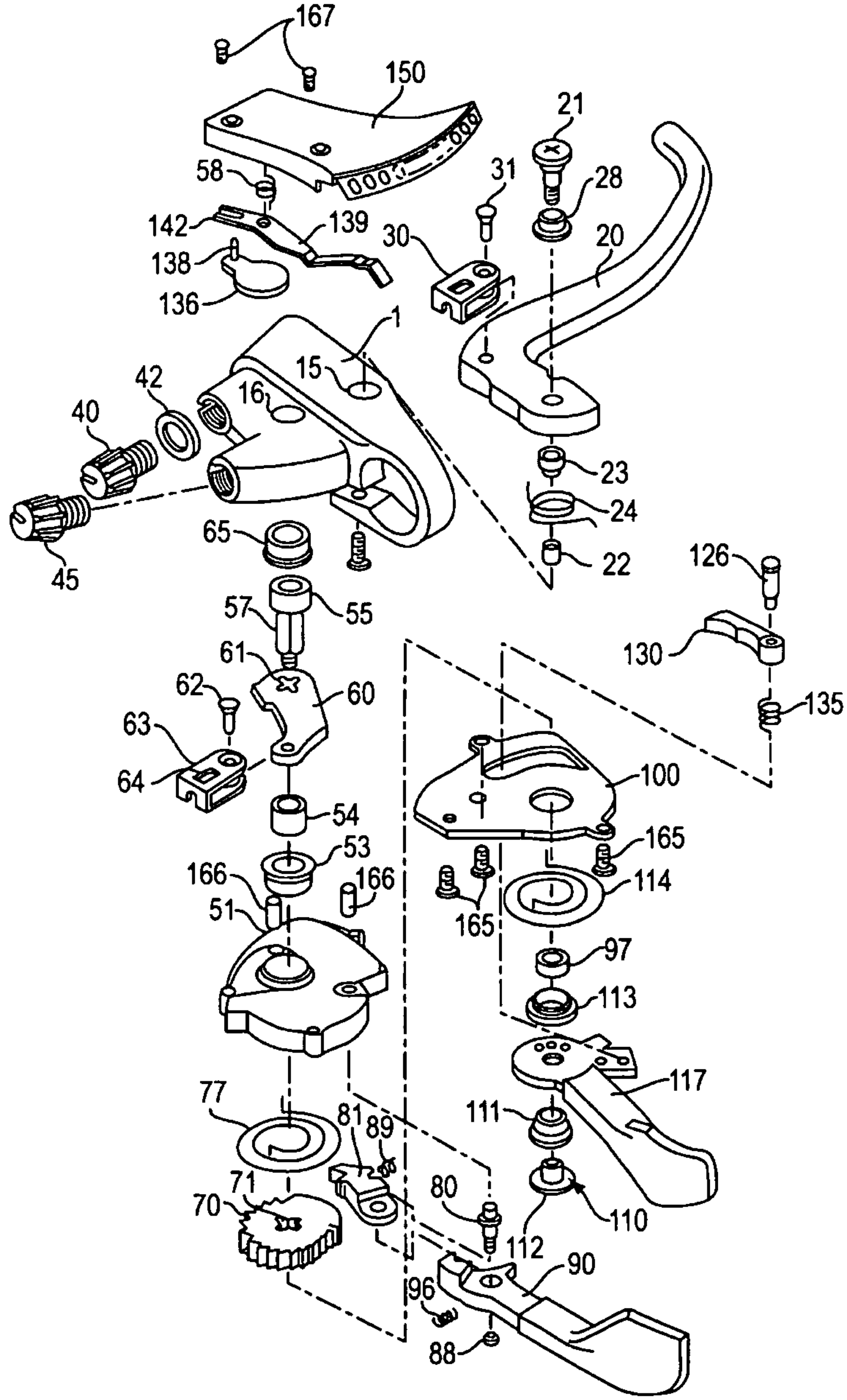

167
150
100
140
142
139
141
138
136
137
26
12
1
166
55
63
50
90
51
117
165
165

FIG. 22


167
150
21
58
31
28
142
139
30
20
138
136
1
15
42
16
40
23
24
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22
45
126
57
55
61
130
62
60
135
63
64
100
54
53
165
166
166
114
51
165
97
113
117
77
111
81
89
71
80
70
110
112
90
96
88

BRAKE AND SHIFTING DEVICE

This is a Continuation of application Ser. No. 08/652,142, filed May 17, 1996, now abandoned.

BACKGROUND OF THE INVENTION

The present invention is directed to bicycle brake and shifting control devices and, more particularly, to a combined bicycle brake and shifting control device wherein the brake and shifting control components are interchangeable while maintaining a compact structure for the combined unit.

Bicycle brake and shifting control devices ordinarily are mounted on the bicycle handlebar so that the cyclist may shift and brake while grasping the handlebar. It is known to integrate the shifting device with the brake device as shown in JP 2-68289 and U.S. Pat. Nos. 4,319,673, 5,241,878 and 5,400,675 in order to reduce the overall size of the two devices. However, the brake and shifting control devices in these patents are not modular and therefore cannot be interchanged with other brake and shifting control devices. It is also known to fasten the shifting control device directly to the brake control device bracket to achieve some reduction in the overall size of the two devices while allowing interchangeability. Such a structure is shown in U.S. Pat. Nos. 5,052,241 and 5,203,213. However, such structures still require separate cable receiving housings and separate housings capable of containing the entire structure of each device. Thus, such structures are still somewhat large, especially when the shifting control device includes ratchet mechanisms which require various ratchet pawls, springs and levers, all of which must be contained within the shift control device housing. Such structures can be unacceptable when competing on a selling or manufacturing cost basis.

SUMMARY OF THE INVENTION

The present invention is directed to a combined bicycle brake and shifting control device wherein the brake and shifting control components are interchangeable while maintaining a compact structure for the combined unit. In one embodiment of the present invention directed to the shifting control device alone, the shifting control device includes a speed change housing, a shift lever, and a shaft disposed within the speed change housing. The shaft is coupled to the shift lever for rotation in response to movement of the shift lever. The shaft extends through an outside surface of the speed change housing so that the shaft terminates in a free end outside the housing and spaced apart from the shift lever. If desired, a ratchet mechanism may be provided to couple the shift lever to the shaft, and the ratchet mechanism may be disposed within the speed change housing. This basic structure may be coupled to a brake lever housing so that the free end of the shaft is disposed within the brake lever housing to perform such functions as winding transmission cable and/or controlling a gear indicating device also disposed on the brake lever housing. To perform the former function, a wire winding member is disposed on the shaft outside the speed change housing. To perform the latter function, the free end of the shaft may include a coupling for transferring motion of the shaft to a speed indicating device.

In the more specific embodiment of the present invention directed to the combined brake and shifting control device, the combined device includes a brake lever housing, a brake lever pivotably coupled to the brake lever housing, a speed change housing, a ratchet mechanism disposed within the

speed change housing, one or more shift levers coupled to the ratchet mechanism so that the ratchet mechanism rotates in response to movement of the shift lever(s), and a shaft coupled to the ratchet mechanism for rotation therewith and extending outside the speed change housing into the brake lever housing. In this embodiment the shift lever shaft has a wire winding member disposed thereon within the brake lever housing for controlling the winding and unwinding of a transmission cable. With this structure the brake lever bracket may comprise a band for fixing the brake lever housing to a bicycle, a first screw component for fixing a brake cable adjusting bolt to the brake lever housing, and a second screw component for fixing a transmission cable adjusting bolt to the brake lever housing. Thus, the screw components may be formed integrally with the brake lever bracket instead of being formed separately on the brake lever and speed change housings.

A speed indicator also may be fastened to the brake lever housing. In one embodiment the speed indicator comprises an indicator cover mounted to an opposite side of the brake lever housing. The indicator cover has an indicator cover projection extending toward the brake lever housing, and a display needle is pivotably coupled to the indicator cover projection. A cam plate is provided for transferring rotational motion of the shaft to the indicator needle. The cam plate includes a shaft coupler extending from one side thereof and coupled to the shaft for rotation therewith, and an indicator coupler extending from an opposite side thereof and fitted within a slit on the indicator needle.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top plan view of a particular embodiment of a combined bicycle brake and shifting control device according to the present invention;

FIG. 2 is a rear elevational view of the combined bicycle brake and shifting control device shown in FIG. 1;

FIG. 3 is a right side view of the combined bicycle brake and shifting control device shown in FIG. 1;

FIG. 4 is a bottom view of the combined bicycle brake and shifting control device shown in FIG. 1;

FIGS. 5(*a*) through 5(*f*) illustrate in detail a particular embodiment of a brake bracket used in the combined bicycle brake and shifting control device shown in FIG. 1, wherein FIG. 5(*b*) is an elevational view of the brake bracket; FIG. 5(*a*) is a left side view of the brake bracket shown in FIG. 5(*b*); FIG. 5(*c*) is a right side view of the brake bracket shown in FIG. 5(*b*); FIG. 5(*d*) is a cross sectional view taken along line 5(*d*)—5(*d*) in FIG. 5(*a*); FIG. 5(*e*) is a cross sectional view taken along line e—e in FIG. 5(*c*); and FIG. 5(*f*) is a reverse view of the brake bracket shown in FIG. 5(*b*);

FIG. 6 is a cross sectional view of a particular embodiment of the brake unit shown in FIG. 1;

FIG. 7 is a cross sectional view taken along line VII—VII in FIG. 6;

FIG. 8 is a cross sectional view of the combined brake and shifting control device shown in FIG. 1;

FIGS. 9(*a*) through (*d*) illustrate in detail a particular embodiment of a base member for the shift unit shown in FIG. 1, wherein FIG. 9(*a*) is a plan view of the base member; FIG. 9(*b*) is a side view of the base member taken along line 9(*b*)—9(*b*) in FIG. 9(*a*); FIG. 9(*c*) is a reverse view of the base member shown in FIG. 9(*a*); and FIG. 9(*d*) is a cross sectional view of the base member taken along line 9(*d*)—9(*d*) in FIG. 9(*a*);

FIGS. 10(*a*) and (*b*) illustrate a particular embodiment of a shift lever shaft shown in FIG. 8, wherein FIG. 10(*a*) is partial cross sectional view of the shift lever shaft, and FIG. 10(*b*) is a cross sectional view of the shift lever shaft taken along line 10(*b*)—10(*b*) in Figure (*a*);

FIGS. 11 (*a*) and (*b*) illustrate a particular embodiment of a ratchet shown in FIG. 8, wherein FIG. 11(*a*) is an elevational view of the ratchet, and FIG. 11(*b*) is a cross sectional view of the ratchet taken along line 11(*b*)—11(*b*) in FIG. 11(*a*);

FIG. 12 is an elevational view of a particular embodiment of a pawl plate shown in FIG. 8;

FIGS. 13(*a*) and (*b*) illustrate a particular embodiment of a positioning pawl shown in FIG. 8, wherein FIG. 13(*a*) is an elevational view of the positioning pawl, and FIG. 13(*b*) is a partial cross sectional view of the positioning pawl;

FIGS. 14(*a*) and (*b*) illustrate a particular embodiment of a return lever shown in FIG. 8, wherein FIG. 14(*a*) is an elevational view of the positioning lever, and FIG. 14(*b*) is a cross sectional view of the positioning lever taken along line 14(*b*)—14(*b*) in FIG. 14(*a*);

FIGS. 15(*a*) through (*e*) illustrate a particular embodiment of a feeding lever shown in FIG. 4, wherein FIG. 15(*a*) is an elevational view of the feeding lever; FIG. 15(*b*) is a right side view of the feeding lever shown in FIG. 15(*a*); FIG. 15(*c*) is a reverse view of the feeding lever shown in FIG. 15(*a*); FIG. 15(*d*) is a left side view of the feeding lever shown in FIG. 15(*a*), and FIG. 15(*e*) is a cross sectional view of the feeding lever taken along line 15(*e*)—15(*e*) in Figure (*b*);

FIGS. 16(*a*) and (*b*) illustrate a particular embodiment of a feeding pawl shown in FIG. 8, wherein FIG. 16(*a*) is an elevational view of the feeding pawl, and FIG. 16(*b*) is, a side view of the feeding pawl;

FIGS. 17(*a*), (*b*), and (*c*) illustrate a particular embodiment of cam plate used with the speed indicator shown in FIG. 1, wherein FIG. 17(*a*) is a plan view of the cam plate; FIG. 17(*b*) is a right side view of the cam plate shown in FIG. 17(*a*), and FIG. 17(*c*) is a rear view of the cam plate shown in FIG. 17(*a*);

FIGS. 18(*a*) and (*b*) illustrate a particular embodiment of a display needle used with the speed indicator shown in FIG. 1, wherein FIG. 18(*b*) is an elevational view of the display needle, and FIG. 18(*a*) is a side view of the display needle;

FIGS. 19(*a*), (*b*), and (*c*) illustrate a particular embodiment of a cover for the speed indicator shown in FIG. 1, wherein FIG. 19(*c*) is a plan view of the cover; FIG. 19(*a*) is a reverse view of the cover shown in FIG. 19(*c*); and FIG. 19(*b*) is a cross sectional view taken along line 19(*b*)—19(*b*) in FIG. 19(*a*);

FIGS. 20(*a*) through (*d*) illustrate the operation of the shift unit, wherein FIGS. 20(*a*) and (*b*) illustrate operations during upshifting (low to high speed), and FIGS. 20(*c*) and (*d*) illustrate operations during down shifting (high to low speed);

FIG. 21 is a partially exploded view of the combined bicycle brake and shifting control device shown in FIG. 1; and

FIG. 22 is a detailed exploded view of the combined bicycle brake and shift device shown in FIG. 1.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Overview

The overall structure of a particular embodiment of a combined brake and shifting control device is shown in FIGS. 1–4, wherein FIG. 1 is a top plan view of the combined bicycle brake and shifting control device, FIG. 2 is a rear elevational view, FIG. 3 is a right side view, and FIG. 4 is a bottom view. Furthermore, FIG. 21 is a partially exploded view of the combined brake and shifting control device showing the major modular units of the device, and FIG. 22 is a detailed exploded view of the combined brake and shifting control device. These figures can be referred to for much of the discussion which follows, with reference to the remaining figures for a detailed description of the individual components as necessary.

As shown generally in FIGS. 1–4, the combined brake and shifting device comprises a brake unit 26, a shift unit 50, and an gear indicator 140. Brake unit 26 includes a brake bracket 1 having an upper surface 2, a brake lever 20, and a band unit 3 for fixing the assembly to a handlebar 12 or other structural member of a bicycle. Shift unit 50 includes a base 51 affixed to brake bracket 1 through positioning pins 166 (FIG. 21) and base lock screws 165, a return lever 90 for downshifting the bicycle transmission, and a feed lever 117 for upshifting the bicycle transmission. As shown in FIG. 21, shift it 50 includes a shift lever shaft 55 which projects outside base 51, and a cable hook 63 for attachment to a transmission cable such as a derailleur cable (not shown) is attached to shift lever shaft 55. As discussed in more detail below, shift lever shaft 55 rotates in response to movement of return lever 90 and feed lever 117 so that cable hook 63 may alternately release and pull the derailleur cable. When fixed to brake bracket 1, shift lever shaft 55 and cable hook 63 are disposed within brake bracket 1. As a result of this structure, shift unit 50 may be selectively attached or removed as a unit from brake bracket 1 for use on another brake and/or shifting device, and a different shift unit may be attached to brake bracket 1 as desired.

As shown more clearly in FIGS. 1 and 5(*d*), brake bracket 1 includes a female screw component 4 for receiving a well known brake cable adjusting bolt 40, and a female screw component 5 for receiving a well known derailleur cable adjusting bolt 45. Since these structures are integrally formed with the brake bracket, and since the brake bracket accommodates part of the shift unit 50 (namely, shift lever shaft 55 and cable hook 63), the resulting structure is more compact while retaining modularity and interchangeableness of the brake and shift units.

Gear indicator 140 includes a gear indicator cover 150, a lens 160 for viewing the currently selected gear, a display needle 139 (FIG. 21), and a cam plate 136. As discussed in more detail below, cam plate 136 communicates the motion of a shift lever shaft 55 of shift unit 50 to display needle 139 for indicating the currently selected gear. Gear indicator cover 150 is fixed to brake bracket 1 through lock screws 167.

Brake Unit

FIG. 6 is a cross sectional view of brake unit 26 shown in FIG. 1, and FIG. 7 is a cross sectional view taken along line VII—VII in FIG. 6. Furthermore, FIGS. 5(*a*) through (*f*) illustrate in detail a particular embodiment of brake bracket 1, wherein FIG. 5(*b*) is an elevational view of the brake bracket; FIG. 5(*a*) is a left side view; FIG. 5(*c*) is a right side view; FIG. 5(*d*) is a cross sectional view taken along line d—d in FIG. 5(*a*); FIG. 5(*e*) is a cross sectional view taken along line e—e in FIG. 5(*c*); and FIG. 5(*f*) is a reverse view of the brake bracket. The exploded view of the combined brake and shifting unit in FIG. 22 also may facilitate understanding of the discussion which follows.

Brake bracket 1 is a light metal, the entirety of which is integrally formed. As noted above, brake bracket 1 consists

of an upper surface 2 forming an external surface that is exposed to the outside, a band unit 3 for fixing the brake bracket to handlebar 12 (FIG. 1), a first female screw component 4 for receiving a brake cable adjusting bolt 40, and a second female screw component 5 for receiving a derailleur cable adjusting bolt 45. The band unit 3 is formed in the shape of a C as shown in FIG. 5(*a*). Part of the external periphery of band unit 3 forms an opening 6, and a round hole 7 in the interior of the band unit 3 has a nearly circular cross section. A through hole 9 is opened in the tip 8 of the band unit 3, and a screw hole 10 is formed in the surface 11 opposite the through hole 9, with the opening 6 serving as a gap between the through hole 9 and screw hole 10. A screw component at the leading end of a bolt 25 (FIG. 7) is inserted through the through hole 9 into the screw hole 10. Thus, when the bolt 25 is rotated, the tip 8 narrows the gap of the opening 6 as it is brought closer to the opening face 11, thus tightening the band unit 3 around the handlebar 12 of the bicycle so that the brake bracket 1 is clamped to the handlebar 12.

As shown more clearly in FIG. 5(*a*), the screw face of the first female screw component 4 is integrally formed with the inner peripheral face of the hole in the brake bracket 1, and a slit 13 is formed in the axial direction behind the position where the first female screw component is formed in the brake bracket 1. The second female screw component 5 is formed at an angle to the axis of, and is adjacent to, the first female screw component 4. The screw face of the second female screw component 5 also is integrally formed with the inner peripheral face of the hole in the brake bracket 1, and a slit 14 is formed in the axial direction to the position where the second female screw component 5 of the brake bracket 1 is formed.

As noted above, the first female screw component 4 receives a brake cable adjusting bolt 40 (FIG. 1), and the second female screw component 5 receives a derailleur cable adjusting bolt 45. The screw component 41 (FIG. 6) of the brake cable adjusting bolt 40 is screwed into the first female screw component 4. The brake cable adjusting bolt 40 moves the brake cables 33 (inner and outer) facing each other to adjust the position of the two relative to each other and to adjust the brake device. The structure of the brake cable adjusting bolt 40 is well known, and a detailed description of its structure will be omitted. A lock nut 42 is screwed into the screw component 41 of the brake cable adjusting bolt 40 and locks the brake cable adjusting bolt 40 and the brake bracket 1.

The screw component of the derailleur cable adjusting bolt 45 for adjusting the derailleur cable is similarly screwed into the second female screw component 5. Derailleur cable adjusting bolt 45 similarly moves the derailleur cables (inner and outer) facing each other to adjust their position relative to each other and to adjust the derailleur.

Two coaxial brake lever shaft insertion holes 15 (FIGS. 5(*b*) and 5(*f*)) are formed on the opposite surfaces of brake bracket 1. One hole supports the head of a brake lever shaft 21 (FIG. 21) through a brake shaft bushing 28, and the other hole supports the threaded component of the brake lever shaft 21 through a threaded cylindrical shaft 22. Brake lever 20 is swingably supported to brake bracket 1 through brake lever shaft 21. Base lock screw insertion holes 200 receive base lock screws 165, and positioning pin insertion holes 204 receive positioning pins 166.

A spring bushing 23 is fitted around the cylindrical shaft 22, and a return spring 24 is fitted and located around the spring bushing 23. One end of the return spring 24 is engaged at the side surface of the brake lever 20, and the other end is engaged at a spring engagement groove 18 (FIG. 5(*c*)) in brake bracket 1. The brake lever 20 is always energized by the spring force of the return spring 24 in the direction returning to the original angle position following braking operations.

A cable hook 30 (FIG. 6) is swingably located by means of a cable hook shaft 31 at the L-shaped corner of the brake lever 20. The cable hook 30 forms a roughly U-shaped configuration, and a through hole 32 is formed in the cable hook 30. A cable nipple 34 for the brake cable 33 is inserted into this through hole 32.

A shift lever shaft hole 16 for the insertion of the shift lever shaft 55 (in the manner implied in FIG. 22 and shown in FIG. 8) is formed through the opposite surfaces of bracket 1 roughly in the center of the bracket as shown in FIGS. 5(*b*) and 5(*f*), and a screw hole 17 is formed at an incline from the upper surface 2 of brake bracket 1 near the shift lever shaft hole 16. A grip adjusting bolt 27 (FIG. 1) is screwed through a grip adjusting plate (not shown in figure) into the screw hole 17, with the tip of grip adjusting bolt 27 in contact with the brake lever 20. The grip adjusting bolt 27 is turned for adjusting the operating angle position of the brake lever 20.

Shift Unit 50

As shown in FIGS. 2 and 3, shift unit 50 is attached to the brake bracket 1 of brake unit 26. In this embodiment, shift unit 50 is a unit for shifting the rear derailleur (not shown in figure) via a derailleur cable. Shift unit 50 can be attachably and detachably mounted as a previously assembled unit on the brake bracket 1. This unit functionality allows different types of shift units 50 to be mounted on the brake bracket 1. Also, shift unit 50 can also be mounted on different types of brake units 26 or brake brackets 1. Because the processes for assembling the brake unit 26 and shift unit 50 can be separate, the assembly process can be simplified and energy can be conserved.

FIG. 8 is a cross sectional view of the combined brake and shifting control device which illustrates details of construction of shift unit 50. The exploded view of the combined brake and shifting control device shown in FIG. 22 also may facilitate understanding of the discussion which follows. As noted above, shift unit 50 includes a base 51 affixed to brake bracket through positioning pins 166 (FIG. 21) and base lock screws 165, a return lever 90 for downshifting the bicycle transmission, and a feed lever 117 for upshifting the bicycle transmission. A ratchet 70 is coupled to return lever 90 and feed lever 117 through a positioning pawl 81 and a feeding pawl 130, respectively. Shift lever shaft 55 is attached to ratchet 70 for rotation therewith so that shift lever shaft 55 rotates in response to movement of return lever 90 and feed lever 117. As noted above, shift lever shaft 55 projects outside base 51, and a cable hook 63 for attachment to a transmission cable (not shown) is attached to shift lever shaft 55 so that the derailleur cable may be alternately released and pulled in response to operation of return lever 90 and feed lever 117. As shown in FIG. 8, shift lever shaft 55 and cable hook 63 are disposed within brake bracket 1 when shift unit 50 is mounted to brake bracket 1. A pawl board 100 covers the lower portion of base 51.

FIGS. 9(*a*)–9(*d*) illustrate the detailed structure of base 51. In this embodiment, base 51 is roughly in the form of a deformed circle with a concave cross section. The center of base 51 is provided with a bushing hole 52 into which is press fitted a bushing 53 (FIG. 8) and a spacer 54. In this embodiment bushing 53 is made of a lubricated sintered alloy. Shift lever shaft 55 is rotatably inserted through spacer

54 as shown in FIG. 8. Three lock screw holes 49 are formed in three locations around base 51 for receiving the base lock screws 165 (FIGS. 8 and 21) used to fasten shift unit 50 to brake bracket 1. Two positioning pin holes 59 for receiving positioning pins 166 (FIGS. 8 and 21) are formed near the lever shaft bushing holes 52 so that base 51 may be properly positioned relative to brake bracket 1. A positioning pawl shaft hole 76 is provided for fixedly receiving a positioning pawl shaft 80 (discussed below), and a return spring hole 78 is provided for receiving an end of a coiled return spring 77 (FIG. 22) for ratchet 70.

FIG. 12 is a plan view of the pawl board 100 which covers the open side of base 51. Pawl board 100 is made of sheet metal and is attached to base 51 through the same lock screws 165 used to secure base 51 to brake bracket 1. These screws extend through holes 105 formed in the outer periphery of pawl board 100. A center hole 102 for supporting the shift lever shaft 55 is located in the center of the pawl board 100, an arcuate hole 103 for accommodating the swinging motion of a feeding pawl shaft 126 (FIG. 8) is formed at the outer periphery of pawl board 100, and a hole 101 is provided for receiving the opposite end of positioning pawl shaft 80. A spring engaging hole 104 is provided for engaging one end of a feeding lever spring 114 (FIG. 22). These structures will be discussed in more detail below.

FIGS. 10(*a*) and (*b*) illustrate shift lever shaft 55, wherein FIG. 10(*a*) is a partial cross sectional view of shift lever shaft 55, and FIG. 10(*b*) is a cross sectional view of shift lever shaft 55 taken along line b—b in Figure (*a*). In this embodiment, shift lever shaft 55 comprises a drum portion 57 having a cross-shaped cross section, a threaded portion 56 formed at one end, and a cam joint hole 58 with a hexagonal cross section formed in the head at the other end. Since the outer periphery of the drum component 57 is in the form of a cylinder, the shift lever shaft 55 is rotatably supported in base 51 by the spacer 54. When shift unit 50 is mounted to brake bracket 1, the head of shift lever shaft 55 is rotatably supported by a bushing 65 fitted in the shift lever shaft hole 16 formed in brake bracket 1.

A winding plate 60 made of sheet metal is fitted at a location near the head of the drum component 57. Winding plate 61 has a cross-shaped through hole 61 which meshes with the cross-shaped section of drum portion of shift lever shaft 55 so that winding plate 60 and shift lever shaft 55 rotate as a unit. A generally U-shaped cable hook 63 is rotatably coupled to a radially outward end of a winding plate 61 through a cable hook shaft 62. Cable hook 63 has the same structure as cable hook 30 for brake cable 33. A through hole 64 is formed in the cable hook 63 for receiving a nipple of a derailleur cable (not shown in figure). Thus, when shift lever shaft 55 rotates, cable hook 63 rotates for pulling and releasing the derailleur cable.

FIGS. 11(*a*) and (*b*) illustrate ratchet 70, wherein FIG. 11(*a*) is an elevational view of ratchet 70 and FIG. 11(*b*) is a cross sectional view of ratchet 70 taken along line b—b in FIG. 11(*a*). As shown in FIG. 11(*a*), a cross-shaped through hole 71 is formed in ratchet 70 for meshing with the cross-shaped drum component 57 of shift lever shaft 55 so that ratchet 70 and shift lever shaft 55 rotate as a unit. A return spring hole 75 is provided for receiving one end of return spring 77 (FIG. 22). As noted above, the other end of return spring 77 is fitted in return spring hole 78 (FIG. 9(*a*)) in base 51. As a result, ratchet 70 is always biased so that it rotates in one direction around the shift lever shaft 55. Six feeding teeth 72, seven positioning teeth 73, and seven return teeth 74 are formed around the ratchet 70. The first and last teeth are used as one stage, so the ratchet 70 in this embodiment involves the use of 8 stages. The feeding teeth 72 begin at point a, the positioning teeth 73 begin at point b, and the return teeth 74 begin at point c.

As noted above, return lever 90 and feed lever 117 are coupled to ratchet 70 through a positioning pawl 81 and a feeding pawl 130. The structure of these levers and pawls, and how they are connected together in the shifting unit, will now be discussed.

One end of positioning pawl shaft 80 is fixed in the positioning pawl shaft hole 76 (FIG. 9(*a*)) in base 51, and the other end of positioning pawl shaft 80 is inserted into hole 101 of pawl board 100 where it is fixed with an E-shaped retaining ring 88. Thus, positioning pawl shaft 80 is firmly and securely fixed at both ends at the base 51 and pawl board 100. Return lever 90 and positioning pawl 81 are fitted on positioning pawl shaft 80.

FIG. 13(*a*) and (*b*) illustrate the detailed structure of positioning pawl 81. One end of the positioning pawl 81 has a through hole 82 for rotatably fitting positioning pawl on positioning pawl shaft 80. The other end of positioning pawl 81 has a feed pawl contact component 83. As discussed in more detail below, feed pawl contact component 83 is intended to come into contact with the feeding pawl 130 to undo the engagement between feeding pawl 130 and feeding teeth 72 of ratchet 70 (see FIG. 20(*c*)). Positioning pawl 81 further includes a ratchet contact component 84 for contacting with the ratchet 70. The ratchet contact component 84 has a curvature virtually identical to the outer diameter of the ratchet 70 and ordinarily is in contact with the outer periphery of the positioning teeth 73 of the ratchet 70. An engaging tooth 85 protrudes from the ratchet contact component 84 for engaging the positioning teeth 73 of the ratchet 70, and a concave spring receiving component 86 is formed on the reverse side of the engaging tooth 85. A spring 89 (FIG. 22) is fitted between the spring receiving component 86 and base 51 for biasing the positioning pawl 81 into the ratchet 70. A return lever contact component 87 is formed on the opposite side of the spring receiving component 86. A positioning pawl contact component 93 of return lever 90 (FIG. 14) presses against return lever contact component 87 for disengaging positioning pawl 81 from ratchet 70 in a manner discussed below.

FIGS. 14(*a*) and (*b*) illustrate a particular embodiment of return lever 90, wherein FIG. 14(*a*) is an elevational view of the return lever, and FIG. 14(*b*) is a cross sectional view of the return lever taken along line b—b in FIG. 14(*a*). Return lever 90 has a through hole 91 for rotatably fitting return lever 90 on positioning pawl shaft 80. A trigger tooth 92 is integrally formed at one end of the return lever 90 for engaging with the inclined tooth surface of the return teeth 74 of the ratchet 70 and for allowing ratchet 70 to rotate in reverse when trigger tooth 92 is disengaged from return teeth 74. A positioning pawl contact component 93 is formed on a side of return lever 90 for pressing against the return lever contact component 87 of positioning pawl 81 so as to disengage the engaging tooth 85 of positioning pawl 81 from the positioning teeth 73 of the ratchet 70 in the manner shown in FIG. 20(*c*). A handle 95 is inserted onto and integrally fixed to the other end 94 of the return lever 90. The handle 95 facilitates finger tactility during operation. A spring 96 (FIG. 22) is disposed between base 51 and return lever 90 for biasing trigger tooth 92 toward ratchet 70.

FIGS. 15(*a*) through (*e*) illustrate the details of construction of feeding lever 117, wherein FIG. 15(*a*) is an elevational view, FIG. 15(*b*) is a right side view, FIG. 15(*c*) is a reverse view, FIG. 15(*d*) is a left side view, and FIG. 15(*e*)

is a cross sectional view taken along line e—e in FIG. 15(*b*). Feed lever 117 includes a feeding lever plate 115 fixed to a feeding lever handle 116. Feeding lever plate 115 has a shaft hole 118 so that feeding lever 117 may be rotatably fitted to shift lever shaft 55 through a feeding lever bushing 110 (FIGS. 8 and 22) and a bushing 111. Feeding lever bushing 110 includes a threaded hole 98 (FIG. 8) for screwing through a tubular spacer 97 onto the threaded portion 56 of shift lever shaft 55. Bushing 111 is fitted around the feeding lever bushing 110 (see FIG. 8), and a head 112 of feed lever bushing 110 retains feeding lever 117 in place.

Feeding lever plate 115 also includes a hole 119 in which is fixed one end of a feeding pawl shaft 126 (FIG. 22). A feeding pawl 130 is rotatably supported on feeding pawl shaft 126 and is biased toward ratchet 70 by a spring 135. When assembled, feeding lever 117 is covered by a feeding lever cover 120 (FIG. 4) which is fastened to feeding lever 117 by a screw 121 which threads into a threaded hole 125 in feeding lever plate 115.

FIGS. 16(*a*) and (*b*) show the detailed structure of feeding pawl 130, wherein FIG. 16(*a*) is an elevational view of feeding pawl 130, and FIG. 16(*b*) is a side view of feeding pawl 130. One end of feeding pawl 130 has a hole 131 for rotatably fitting feeding pawl 130 on feeding pawl shaft 126, and the other end of feeding pawl 130 includes a tooth 132 for engaging the feeding teeth 72 of ratchet 70. An arcuate ratchet contact surface 133 is formed at a location near the feeding tooth 132 for guiding the feeding pawl 130 in contact with the outer periphery of the ratchet 70. Another arcuate positioning tooth contact surface 134 is formed adjacent to the ratchet contact surface 133 for contacting the feeding pawl contact component 83 (FIG. 13(*a*)) of the positioning pawl 81. The feeding pawl contact component 83 presses against positioning tooth contact surface 134 for disengaging the feeding tooth 132 from the feeding teeth 72 of the ratchet 70 as shown in FIG. 20(*c*).

FIGS. 20(*a*) through (*d*) illustrate the operation of the shift unit, wherein FIGS. 20(*a*) and (*b*) illustrate operations during upshifting (low to high speed), and FIGS. 20(*c*) and (*d*) illustrate operations during down shifting (high to low speed). First, operation of a rear derailleur from first gear to second gear will be described. FIGS. 20(*a*) and (*b*) illustrate the operation of the shift unit 50 at this time.

When the feeding lever 117 is first pressed with the thumb, it pivots on the shift lever shaft 55, causing the feeding pawl shaft 126 and feeding pawl 130 to swing. This swinging causes the feeding tooth 132 of the feeding pawl 130 to press against the feeding teeth 72 of the ratchet 70 so as to rotate the ratchet 70 from the state shown in FIG. 20(*a*) to the state shown in FIG. 20(*b*). At this time the engaging tooth 85 of the positioning pawl 81 engages the next positioning tooth 73 of the ratchet 70 for maintaining ratchet 70 in the position shown in FIG. 20(*b*). As ratchet 70 rotates, shift lever shaft 55 rotates accordingly and cable hook 63 pulls the inner cable of the derailleur cable. Upshifting to the other gears occurs in the same manner until the shift unit is in the eighth gear position.

The operation of shift unit 50 when shifting down from eighth gear to seventh gear will now be described with reference to FIGS. 20(*c*) and (*d*). When the handle 95 of the return lever 90 is swung in the direction (a) indicated in FIG. 20(*a*), the trigger tooth 92 of the return lever 90 contacts with the return teeth 74 of the ratchet 70 to prevent uncontrolled movement of ratchet 70. At the same time, positioning pawl contact component 93 of return lever 90 presses against return lever contact component 87 of positioning pawl 81 for disengaging engaging tooth 85 from ratchet 70. Similarly, feed pawl contact component 83 of positioning pawl 81 presses against feeding pawl 130 to disengage tooth 132 from ratchet 70. When return lever 90 is released, ratchet 70 moves by one position tooth to the position shown in FIG. 20(*d*) as a result of the biasing action of return spring 77, whereupon engaging tooth 85 of positioning pawl 81 maintains ratchet 70 in this position until further operation of feeding lever 117 or return lever 90.

Indicator 140

As noted above, gear indicator 140 includes a gear indicator cover 150 (FIG. 21), a lens 160 for viewing the currently selected gear, a display needle 139, and a cam plate 136. Gear indicator cover 150 is fixed to brake bracket 1 through lock screws 167. Cam plate 136 communicates the motion of a shift lever shaft 55 of shift unit 50 to display needle 139 for indicating the currently selected gear. In this embodiment, the indicator 140 can indicate seven shifting stages.

FIGS. 17(*a*), (*b*), and (*c*) illustrate the detailed structure of cam plate 136, wherein FIG. 17(*a*) is a plan view, FIG. 17(*b*) is a right side view, and FIG. 17(*c*) is a rear view. Cam plate 136 has a joint 137 on one side and a shaft 138 on the opposite side. When indicator 140 is mounted to brake bracket 1, joint 137 is inserted into cam joining hole 58 (see FIG. 10) at the top end of the shift lever shaft 55. Joint 137 consists of two components with an L-shaped cross section. The outer diameter of joint 137 is somewhat larger than that of the cam joining hole 58 so that joint 137 can be fixed merely by pinching the two components upon insertion in to cam joining hole 58. Thus, cam plate 136 rotates together with shift lever shaft 55.

FIGS. 18(*a*) and (*b*) illustrate the details of display needle 139, wherein FIG. 18(*b*) is an elevational view of display needle 139, and FIG. 18(*a*) is a side view of the display needle 139. Display needle 139 is made of a bent member. A shaft hole 141 is formed in display needle 139 so that display needle 139 may be rotatably fitted to a shaft 151 (FIG. 19) on cover 150. A slit 142 is formed at one end of display needle 139 for receiving shaft 133 of the cam plate 131. Thus, display needle 139 swings when cam plate 131 swings.

The center 143 of the display needle 139 is bent at an angle θ_1. In an assembled state, the tip 144 is further bent to θ_2. The tip surface 145 of the tip 144 is coated with a pink paint containing a fluorescent agent. The shift position is indicated from the lens 160 of the cover 150 by the indicator at the tip surface 145 of the display needle 139.

FIGS. 19(*a*), (*b*), and (*c*) illustrate the detailed construction of cover 150, wherein FIG. 19(*c*) is a plan view of the cover, FIG. 19(*a*) is a reverse view of the cover, and FIG. 19(*b*) is a cross sectional view taken along line b—b in FIG. 19(*a*). In this embodiment cover 150 is made of a synthetic resin. As noted above, the shaft 151 on the underside of cover 150 is inserted into the shaft hole 141 of the display needle 139 for rotatably supporting display needle 139.

Cover 150 has two lock screw holes 152. Lock screws 167 are inserted into these lock. screw holes 152 for fixing cover 150 to brake bracket 1. Lens attachment holes 154 for attaching the lens 160 are provided in two locations on the front of cover 150 for attaching lens 160. Cover 150 extends from the back end toward the front end thereof in a gradually upward-facing curve 153. Curve 153 allows the indicator 140 to be located on the bicycle handlebar when it is attached to the bicycle, and allows the gear position of the rear derailleur to be viewed at a glance.

While the above is a description of various embodiments of the present invention, further modifications may be employed without departing from the spirit and scope of the present invention. Thus, the scope of the invention should not be limited by the specific structures disclosed. Instead, the true scope of the invention should be determined by the following claims. Of course, although labeling symbols are used in the claims in order to facilitate reference to the figures, the present invention is not intended to be limited to the constructions in the appended figures by such labeling.

What is claimed is:

1. A combined bicycle brake and shifting device comprising:

a brake lever housing (1);

a brake lever (20) pivotably coupled to the brake lever housing (1) for rotation around a brake lever axis to operate a braking device;

a shift unit (50) including:

a speed change housing (51);

a ratchet mechanism (70) disposed within the speed change housing (51);

a shift lever (90,117) coupled to the ratchet mechanism (70) so that the ratchet mechanism (70) rotates in response to movement of the shift lever (90,117); and

a shaft (55) coupled to the ratchet mechanism (70) for rotation around a shaft axis parallel to the brake lever axis in response to rotation of the ratchet mechanism (70) and extending outside the speed change housing (51) into the brake lever housing (1), the shift lever shaft (55) having a wire winding member (60) disposed thereon within the brake lever housing (1).

2. The device according to claim 1 wherein the brake lever housing comprises:

a band (3) for fixing the brake lever housing (1) to a bicycle;

a first screw component (4) for fixing a brake cable adjusting bolt (40) to the brake lever housing (1); and

a second screw component (5) for fixing a transmission cable adjusting bolt (45) to the brake lever housing (1).

3. The device according to claim 1 wherein the means for attaching and detaching the shift unit (50) includes a fastener (165) extending through the speed change housing (51) and into the brake lever housing (1).

4. The device according to claim 1 further comprising means for attaching and detaching the shift unit (50) from the brake lever housing (1) so that the speed change housing (51), the ratchet mechanism (70), the shift lever (90,117) and the shaft (55) can remain assembled to each other when the shift unit is detached from the brake lever housing (1).

5. A combined bicycle brake and shifting device comprising:

a brake lever housing (1);

a brake lever (20) pivotably coupled to the brake lever housing (1) for rotation around a brake lever axis to operate a braking device;

a shift unit (50) including:

a speed change housing (51) immovably mounted to the brake lever housing (1);

a ratchet mechanism (70) disposed within the speed change housing (51);

a shift lever (90,117) coupled to the ratchet mechanism (70) so that the ratchet mechanism (70) rotates in response to movement of the shift lever (90,117); and

a shaft (55) coupled to the ratchet mechanism (70) for rotation around a shaft axis parallel to the brake lever axis in response to rotation of the ratchet mechanism (70) and extending outside the speed change housing (51) into the brake lever housing (1), the shift lever shaft (55) having a wire winding member (60) disposed thereon within the brake lever housing (1).

6. The device according to claim 5 wherein the speed change housing (51) is mounted to an external side of the brake lever housing (1).

7. The device according to claim 6 wherein the speed change housing (51) is disposed entirely external to the brake lever housing (1).

8. The device according to claim 5 further comprising a fastener (165) extending through the speed change housing (51) and into the brake lever housing (1) for mounting the speed change housing (51) to the brake lever housing (1).

9. The device according to claim 8 wherein the fastener (165) comprises a screw.

10. A combined bicycle brake and shifting device comprising:

a brake lever housing (1);

a brake lever (20) pivotably coupled to the brake lever housing (1) for rotation around a brake lever axis to operate a braking device;

a shift unit (50) including:

a speed change housing (51);

a ratchet mechanism (70) disposed within the speed change housing (51);

a shift lever (90,117) coupled to the ratchet mechanism (70) so that the ratchet mechanism (70) rotates in response to movement of the shift lever (90,117);

a shaft (55) coupled to the ratchet mechanism (70) for rotation around a shaft axis parallel to the brake lever axis in response to rotation of the ratchet mechanism (70) and extending outside the speed change housing (51) into the brake lever housing (1), the shift lever shaft (55) having a wire winding member (60) disposed thereon within the brake lever housing (1); and

a fastener (165) separate from the shaft (55) for mounting the speed change housing (51) to the brake lever housing (1).

11. The device according to claim 10 wherein the fastener (165) extends through the speed change housing (51) to the brake lever housing (1).

12. The device according to claim 11 wherein the fastener (165) extends into the brake lever housing (1).

13. The device according to claim 12 wherein the fastener (165) comprises a screw.

14. A combined bicycle brake and shifting device comprising:

a brake lever housing (1);

a brake lever (20) pivotably coupled to the brake lever housing (1);

a speed change housing (51);

a ratchet mechanism (70) disposed within the speed change housing (51);

a shift lever (90,117) coupled to the ratchet mechanism (70) so that the ratchet mechanism (70) rotates in response to movement of the shift lever (90,117);

a shaft (55) coupled to the ratchet mechanism (70) for rotation therewith and extending outside the speed change housing (51) into the brake lever housing (1), the shift lever shaft (55) having a wire winding member (60) disposed thereon within the brake lever housing (1);

an indicator cover (150) mounted to an opposite side of the brake lever housing (1), the indicator cover (150)

having an indicator cover projection (151) extending toward the brake lever housing (1);

a display needle (139) pivotably coupled to the indicator cover projection (151), the indicator needle (139) having a slit (142) on one end thereof;

a cam plate (136) for transferring rotational motion of the shaft (55) to the indicator needle (139), the cam plate (136) including:

a shaft coupler (137) extending from one side thereof and coupled to the shaft (55) for rotation therewith; and

an indicator coupler (138) extending from an opposite side thereof and fitted within the slit (142) on the indicator needle (139).

15. A combined bicycle brake and shifting device comprising:

a brake lever housing (1);

a brake lever (20) pivotably coupled to the brake lever housing (1) for rotation around a brake lever axis to operate a braking device;

a shift unit (50) including:

a speed change housing (51);

a ratchet mechanism (70) disposed within the speed change housing (51);

a return lever (90) coupled to the ratchet mechanism (70) so that the ratchet mechanism (70) rotates in response to movement of the return lever (90);

a feed lever (117) coupled to the ratchet mechanism (70) so that the ratchet mechanism (70) rotates in response to movement of the feed lever (117);

a shaft (55) coupled to the ratchet mechanism (70) for rotation around a shaft axis parallel to the brake lever axis in response to rotation of the ratchet mechanism (70) and extending outside the speed change housing (51) into the brake lever housing (1), the shift lever shaft (55) having a wire winding member (60) disposed thereon within the brake lever housing (1).

16. The device according to claim 15 wherein the brake lever housing comprises:

a band (3) for fixing the brake lever housing (1) to a bicycle;

a first screw component (4) for fixing a brake cable adjusting bolt (40) to the brake lever housing (1); and

a second screw component (5) for fixing a transmission cable adjusting bolt (45) to the brake lever housing (1).

17. The device according to claim 15 wherein the means for attaching and detaching the shift unit (50) includes a fastener (165) extending through the speed change housing (51) and into the brake lever housing (1).

18. The device according to claim 15 further comprising means for attaching and detaching the shift unit (50) from the brake lever housing (1) so that the speed change housing (5l), the ratchet mechanism (70), the shift lever (90,117) and the shaft (55) can remain assembled to each other when the shift unit is detached from the brake lever housing (1).

19. A combined bicycle brake and shifting device comprising:

a brake lever housing (1);

a brake lever (20) pivotably coupled to the brake lever housing (1);

a speed change housing (51);

a ratchet mechanism (70) disposed within the speed change housing (51);

a return lever (90) coupled to the ratchet mechanism (70) so that the ratchet mechanism (70) rotates in response to movement of the return lever (90);

a feed lever (117) coupled to the ratchet mechanism (70) so that the ratchet mechanism (70) rotates in response to movement of the feed lever (90);

a shaft (55) coupled to the ratchet mechanism (70) for rotation therewith and extending outside the speed change housing (51) into the brake lever housing (1), the shift lever (55) having a wire winding member (60) disposed thereon within the brake lever housing (1);

an indicator cover (150) mounted to an opposite side of the brake lever housing (1), the indicator cover (150) having an indicator cover projection (151) extending toward the brake lever housing (1);

a display needle (139) pivotably coupled to the indicator cover projection (151), the indicator needle (139) having a slit (142) on one end thereof;

a cam plate (136) for transferring rotational motion of the shaft (55) to the indicator needle (139), the cam plate (136) including:

a shaft coupler (137) extending from one side thereof and coupled to the shaft (55) for rotation therewith; and

an indicator coupler (138) extending from an opposite side thereof and fitted within the slit (142) on the indicator needle (139).

20. A combined bicycle brake and shifting device comprising:

a brake lever housing (1);

a brake lever (20) pivotably coupled to the brake lever housing (1) for rotation around a brake lever axis to operate a braking device;

a speed change housing (51);

a ratchet mechanism (70) disposed within the speed change housing (51);

a return lever (90) coupled to the ratchet mechanism (70) so that the ratchet mechanism (70) rotates in response to movement of the return lever (90);

a feed lever (117) coupled to the ratchet mechanism (70) so that the ratchet mechanism (70) rotates in response to movement of the feed lever (90);

a shaft (55) coupled to the ratchet mechanism (70) for rotation around a shaft axis parallel to the brake lever axis in response to rotation of the ratchet mechanism (70) and extending outside the speed change housing (51) into the brake lever housing (1), the shift lever shaft (55) having a wire winding member (60) disposed thereon within the brake lever housing (1);

wherein the ratchet mechanism (70) includes:

an opening (71) for receiving the shaft (55) therethrough so that the shaft (55) rotates together with the ratchet mechanism;

a plurality of feeding teeth (72) disposed on an outer periphery thereof;

a plurality of positioning teeth (73) disposed on an outer periphery thereof; and

a plurality of return teeth (74) disposed on an outer periphery thereof.

21. The device according to claim 20 wherein the return lever (90) includes a trigger tooth (92) for selectively engaging the plurality of return teeth (74), and further comprising:

a positioning pawl (81) for selectively coupling the return lever (90) to the plurality of positioning teeth (73); and

a feeding pawl (130) for selectively coupling the feeding lever (117) to the plurality of feeding teeth (72).

* * * * *

US005941125A

United States Patent [19]

Watarai et al.

[11] **Patent Number: 5,941,125**

[45] **Date of Patent: Aug. 24, 1999**

[54] **BICYCLE SHIFTING APPARATUS HAVING REMOTELY LOCATED LEVERS FOR OPERATING A SINGLE TRANSMISSION**

[75] Inventors: **Etsuyoshi Watarai**, Izumi; **Kenji Ose**; **Noriaki Takahashi**, both of Sakai, all of Japan

[73] Assignee: **Shimano, Inc.**, Osaka, Japan

[21] Appl. No.: **08/995,276**

[22] Filed: **Dec. 19, 1997**

Related U.S. Application Data

[63] Continuation-in-part of application No. 08/770,982, Dec. 20, 1996, abandoned, which is a continuation-in-part of application No. 08/579,931, Dec. 28, 1995, abandoned.

[30] **Foreign Application Priority Data**

Dec. 19, 1996 [JP] Japan 8-340016

[51] **Int. Cl.**^{6} **B62M 25/04**; B62K 23/06; G05G 11/00

[52] **U.S. Cl.** .... **74/473.14**; 74/480 R; 74/489; 74/502.2

[58] **Field of Search** .... 74/473.13, 473.14, 74/480 R, 489, 502.2

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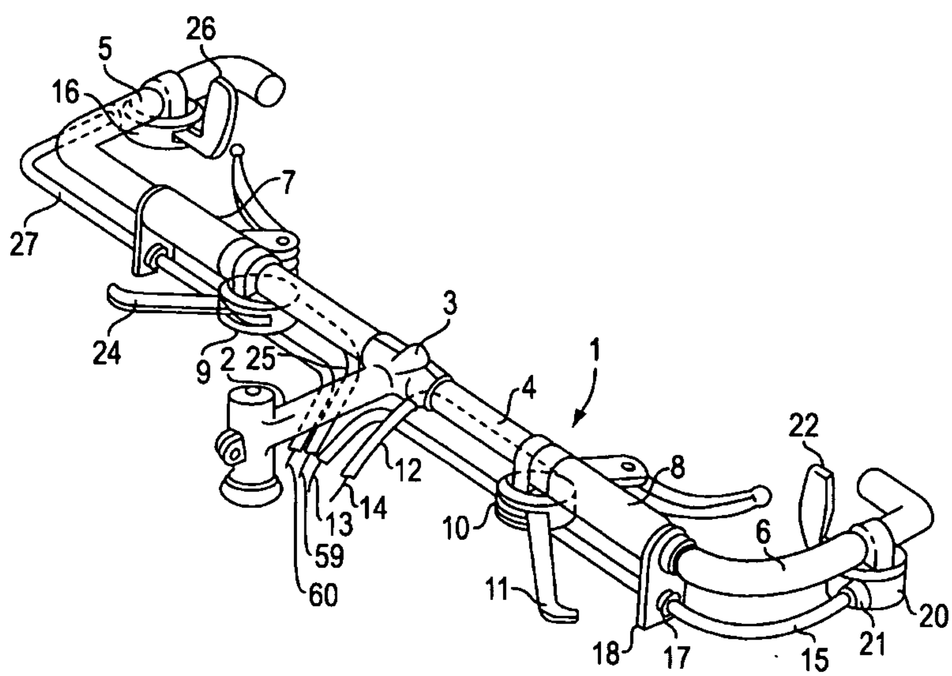
Primary Examiner—Allan D. Herrmann
Attorney, Agent, or Firm—James A. Deland

[57] **ABSTRACT**

A first shifting control device is located at a first position on the bicycle, and a second shifting control device is located at a second position on the bicycle. The first shifting control device includes a first shifting lever for causing the first shifting control device to pull and release a first transmission element, and the second shifting control device includes a second shifting lever for causing the second shifting control device to pull and release a second transmission element. An interlocking mechanism interlocks the first shifting lever and the second shifting lever so that movement of either the first shifting lever or the second shifting lever causes the bicycle shifting control apparatus to shift the bicycle transmission.

65 Claims, 22 Drawing Sheets



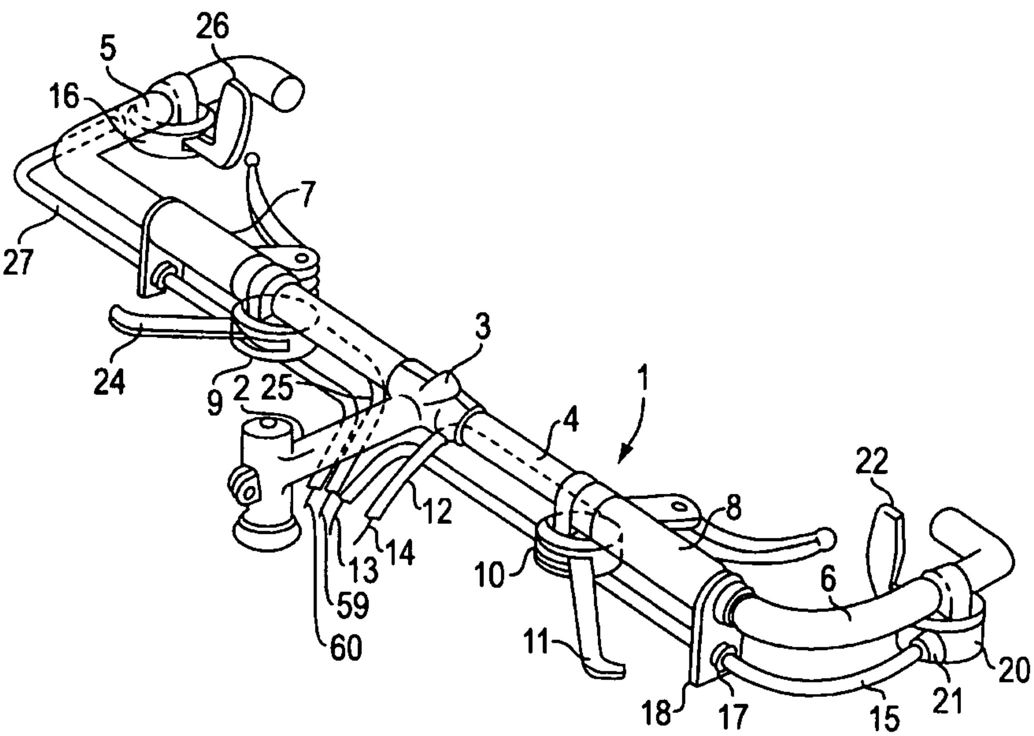


FIG. 1

FIG. 2

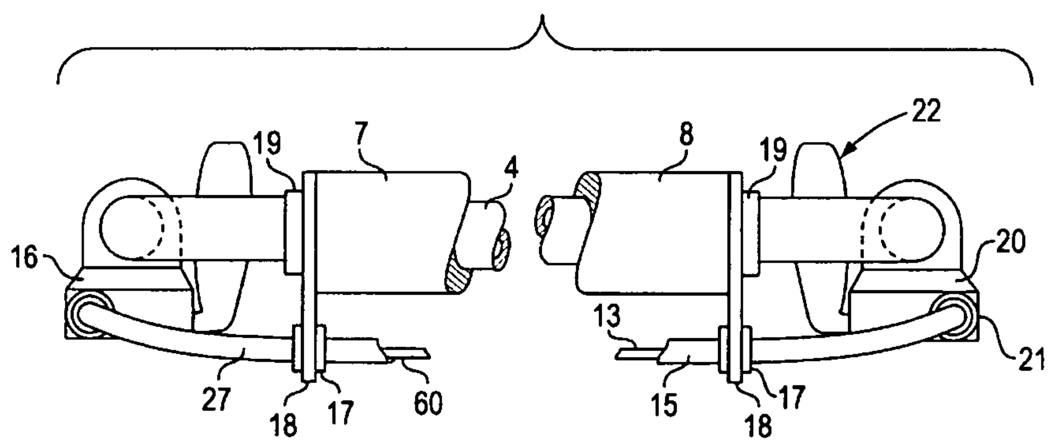


FIG. 3

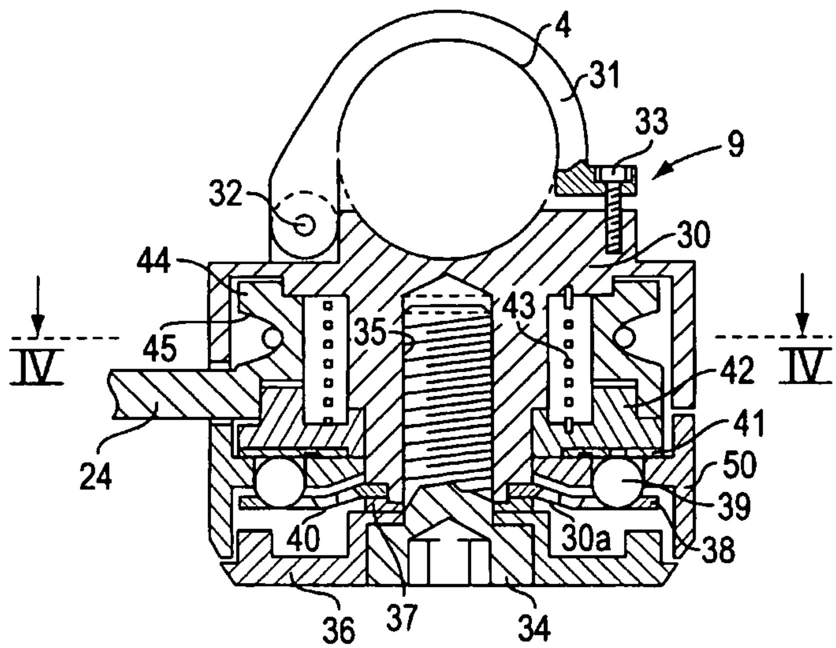


FIG. 4

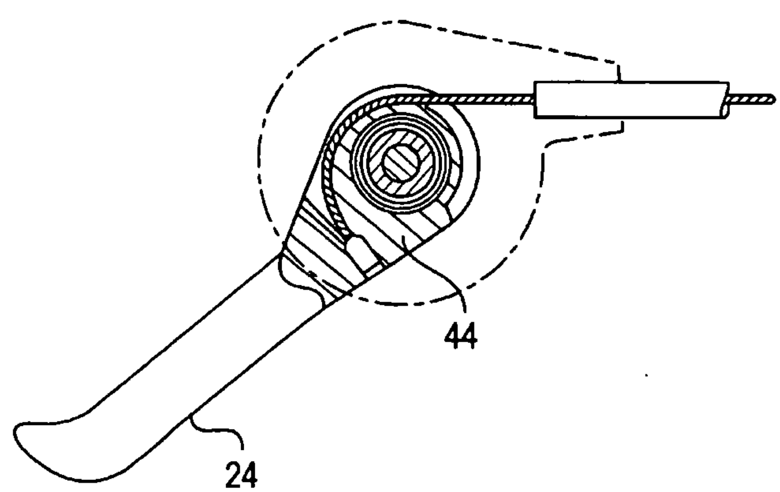


FIG. 5

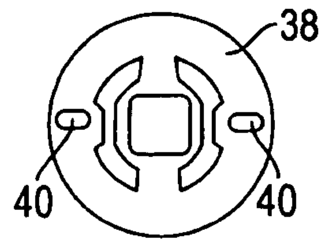


FIG. 6

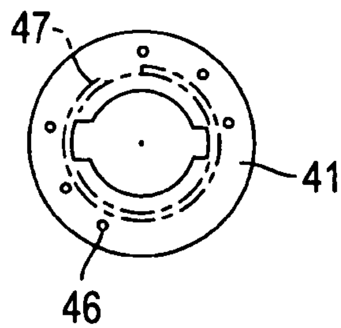


FIG. 7

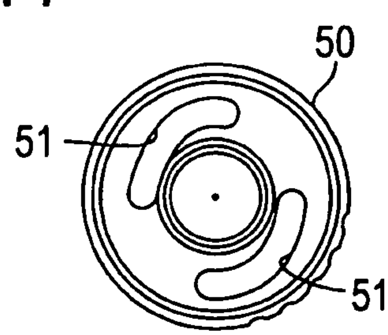


FIG. 8

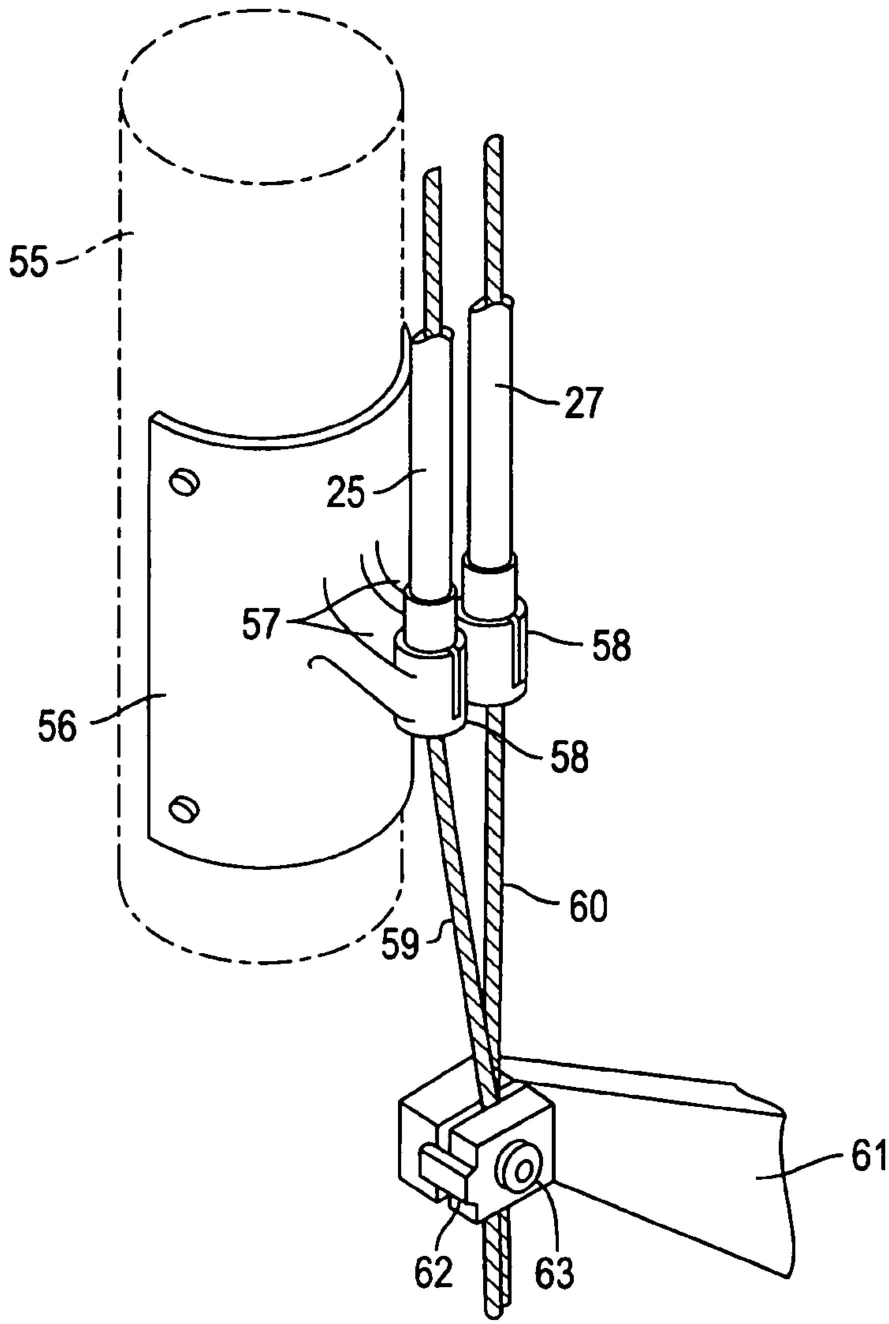


FIG. 9(a)

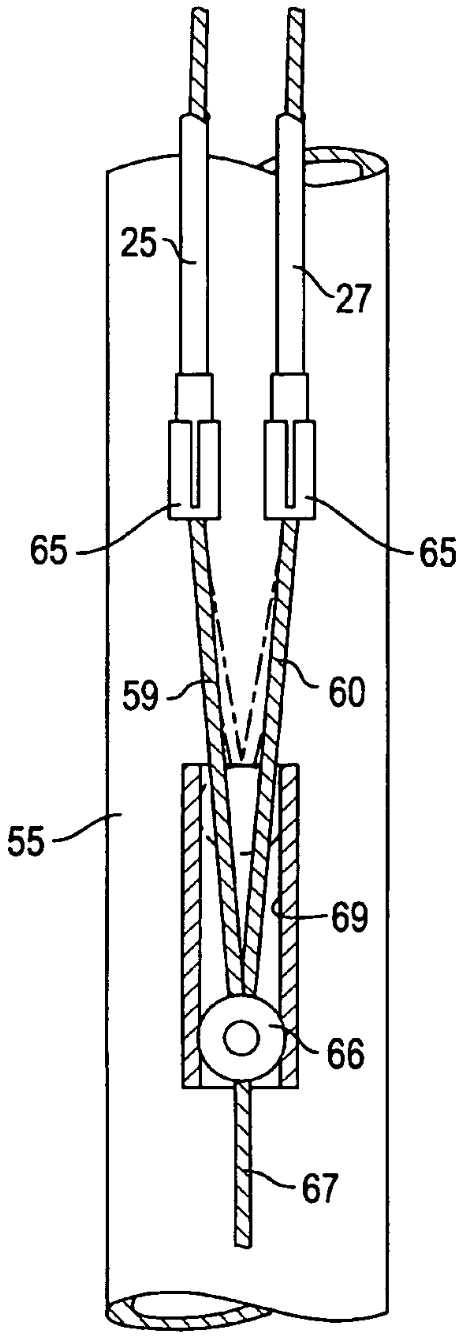
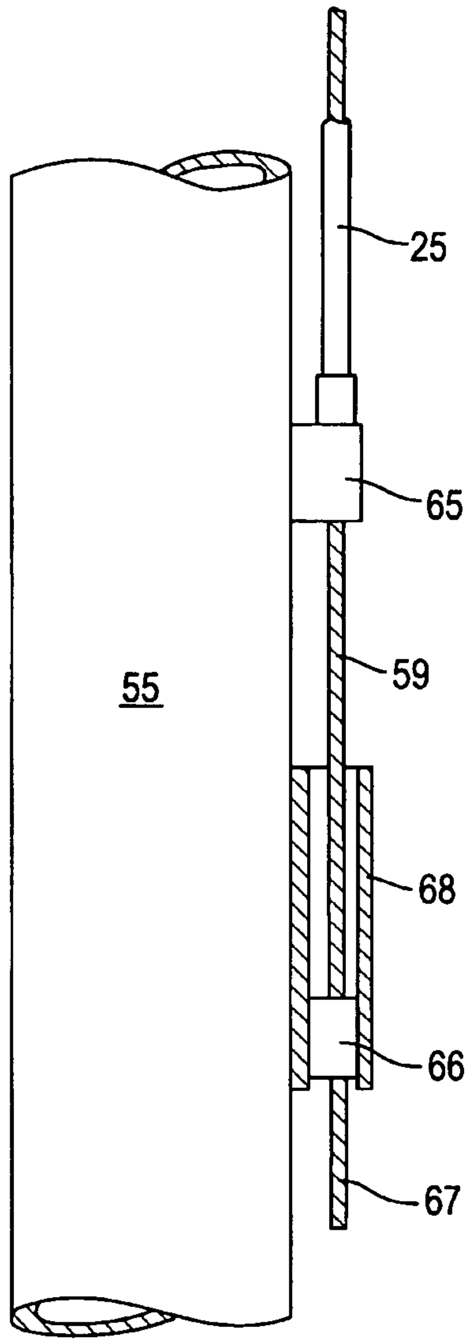


FIG. 9(b)



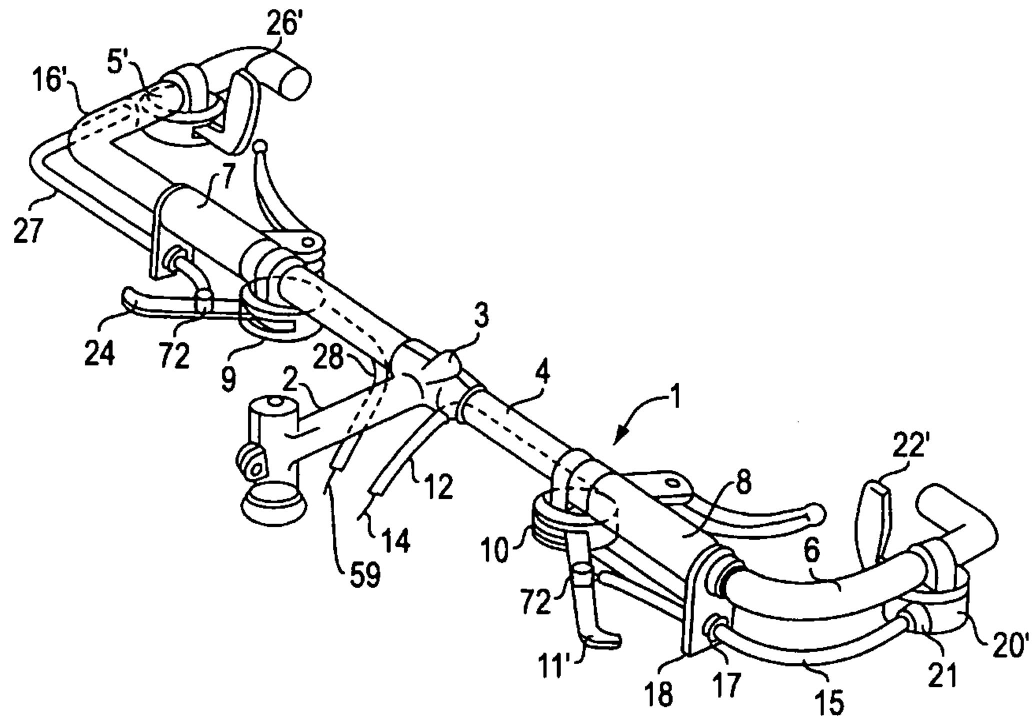


FIG. 10

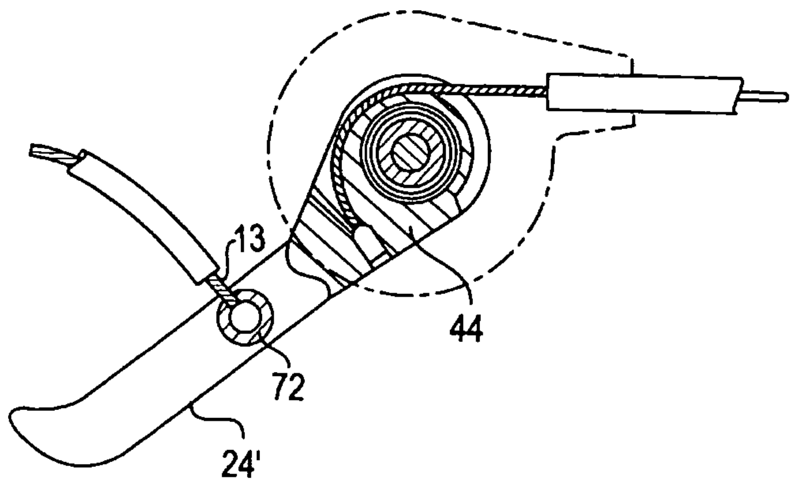


FIG. 11

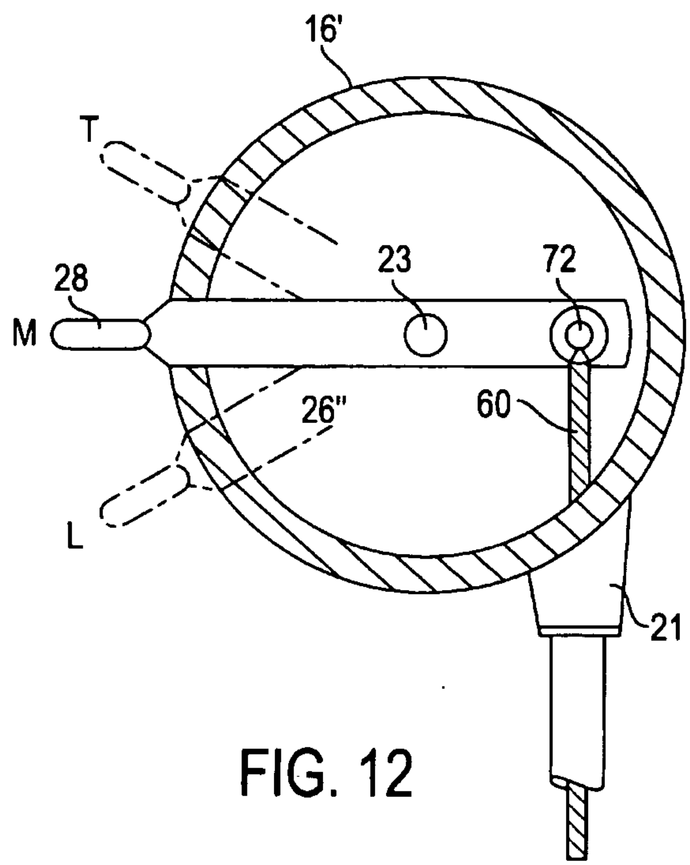
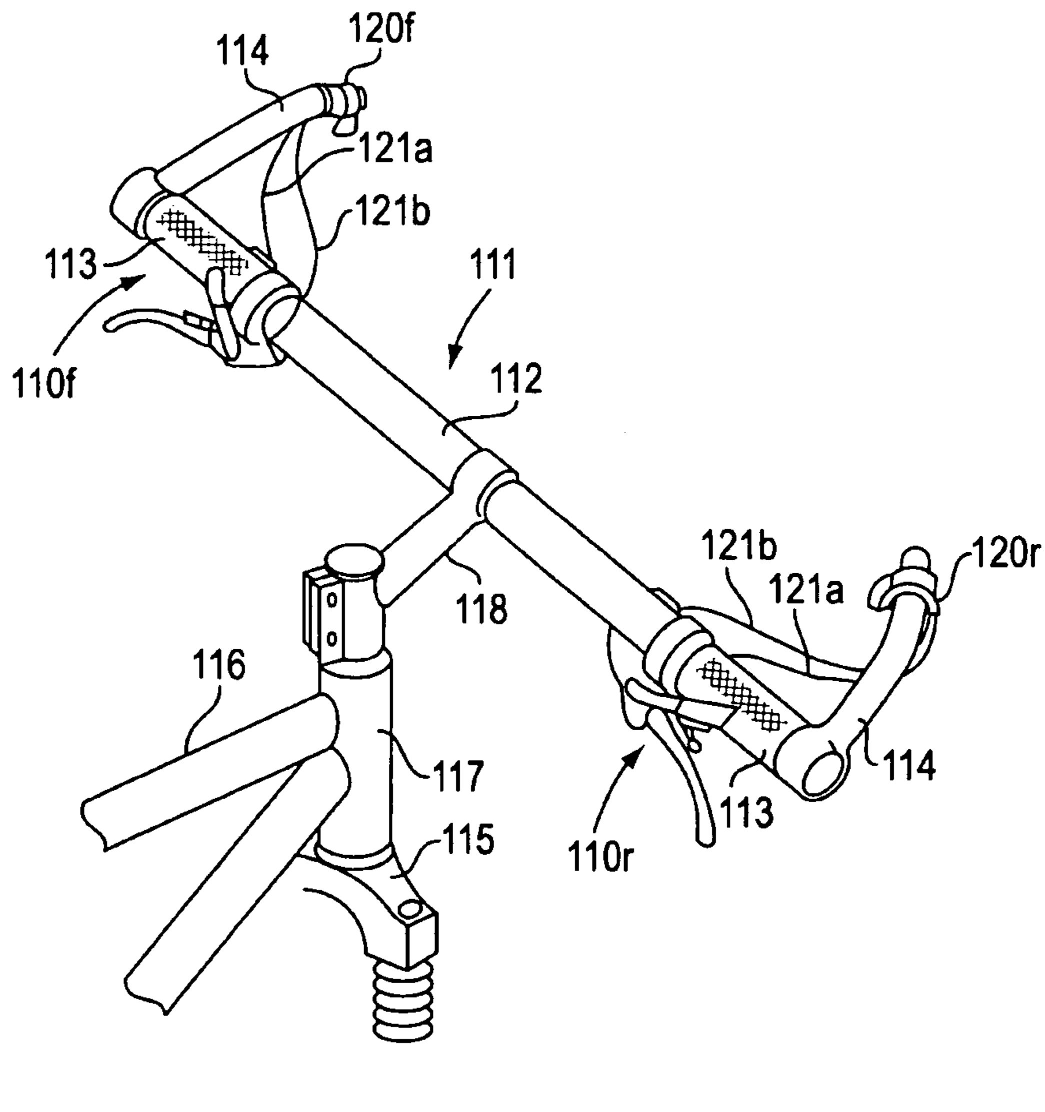


FIG. 12

FIG. 13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110f
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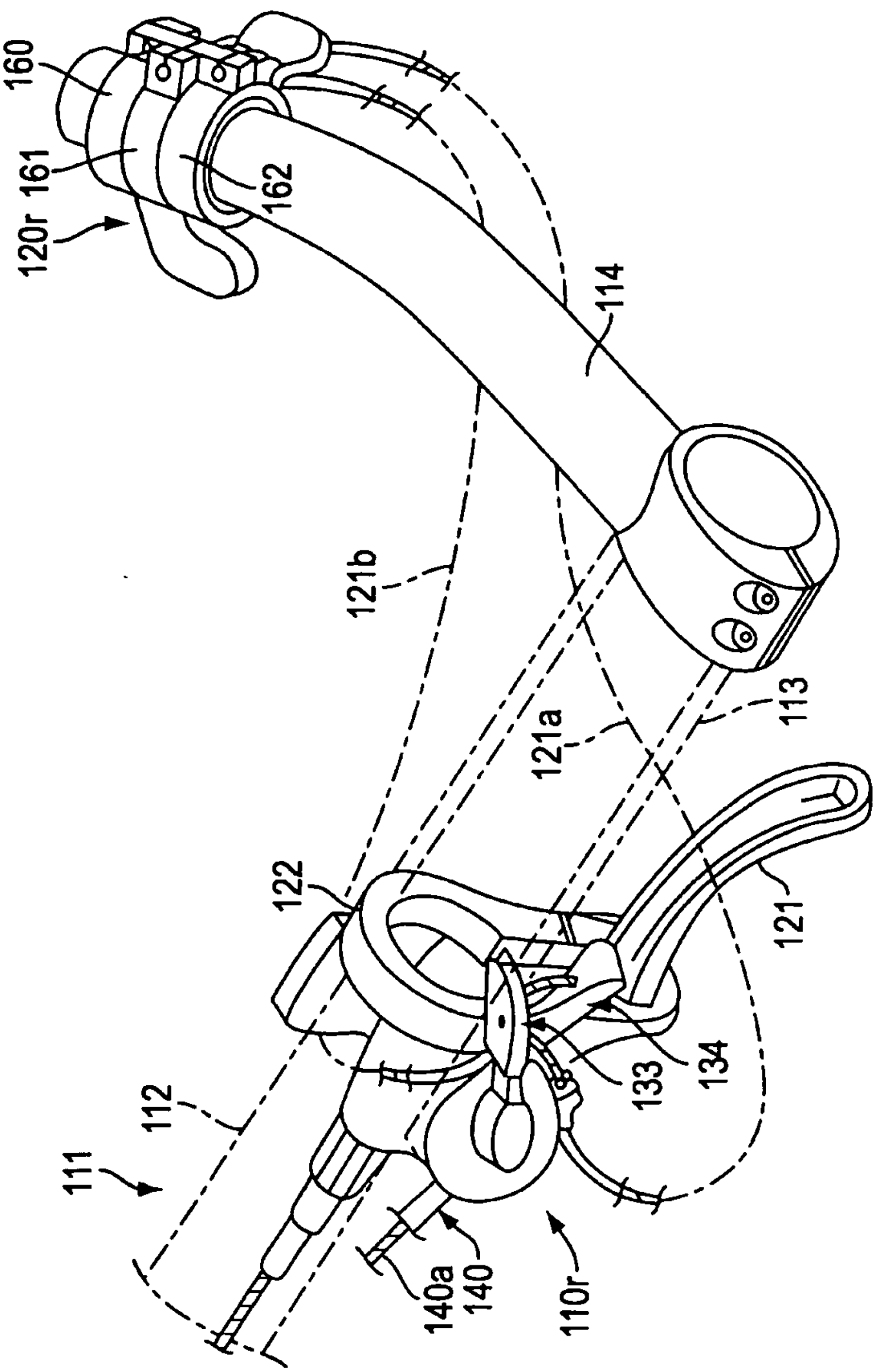
118
116
121b
121a
120r
117
114
113
115
110r

FIG. 14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140a
140
110r

FIG. 15

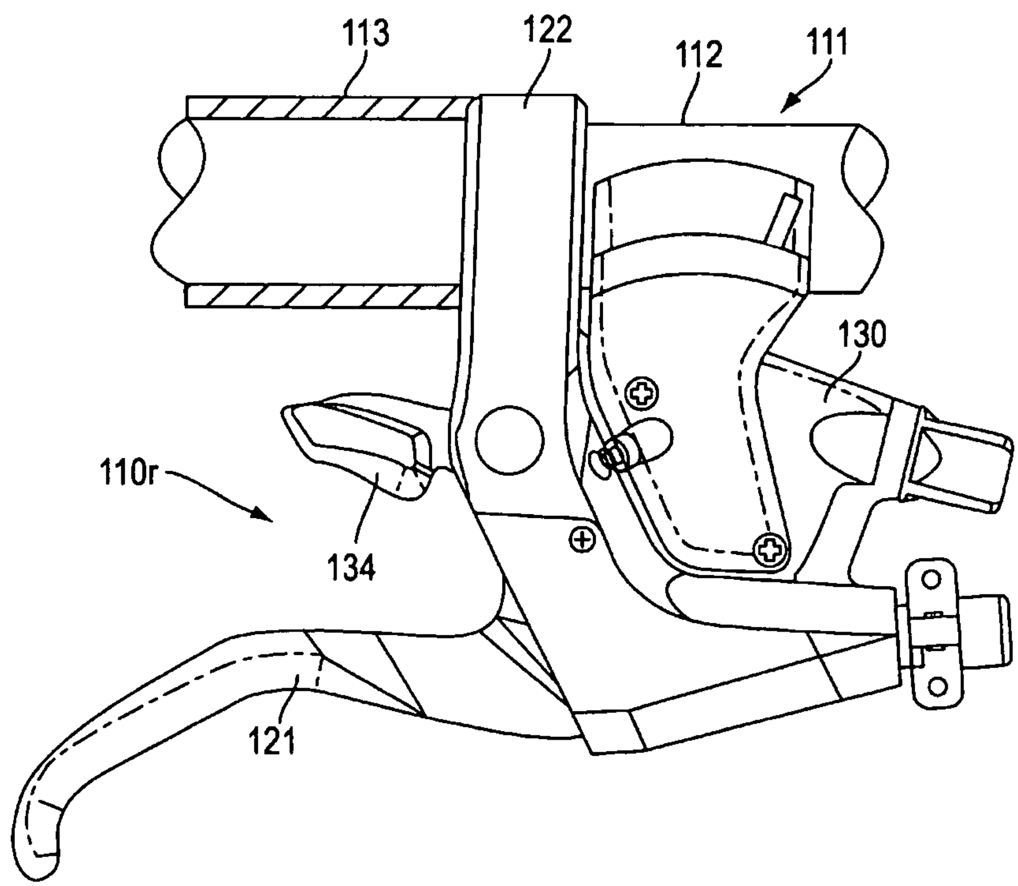
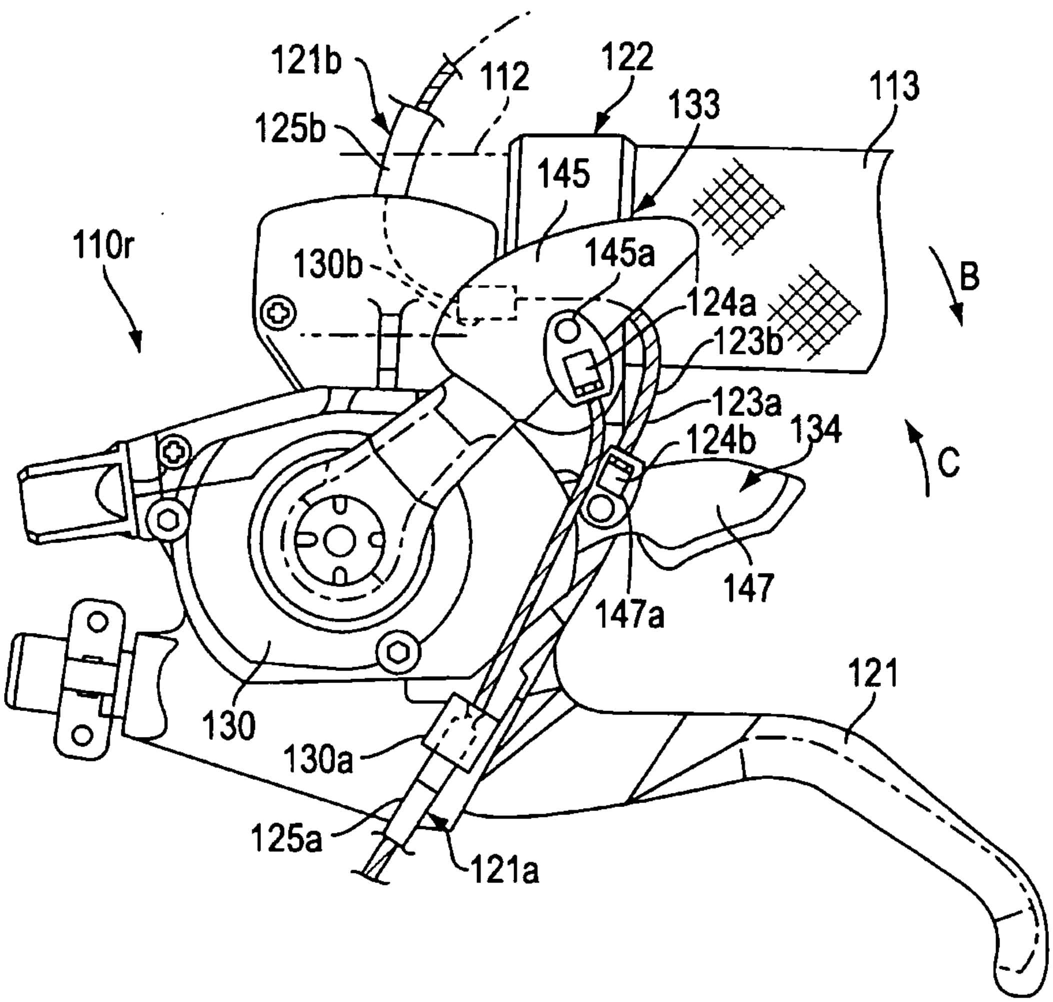
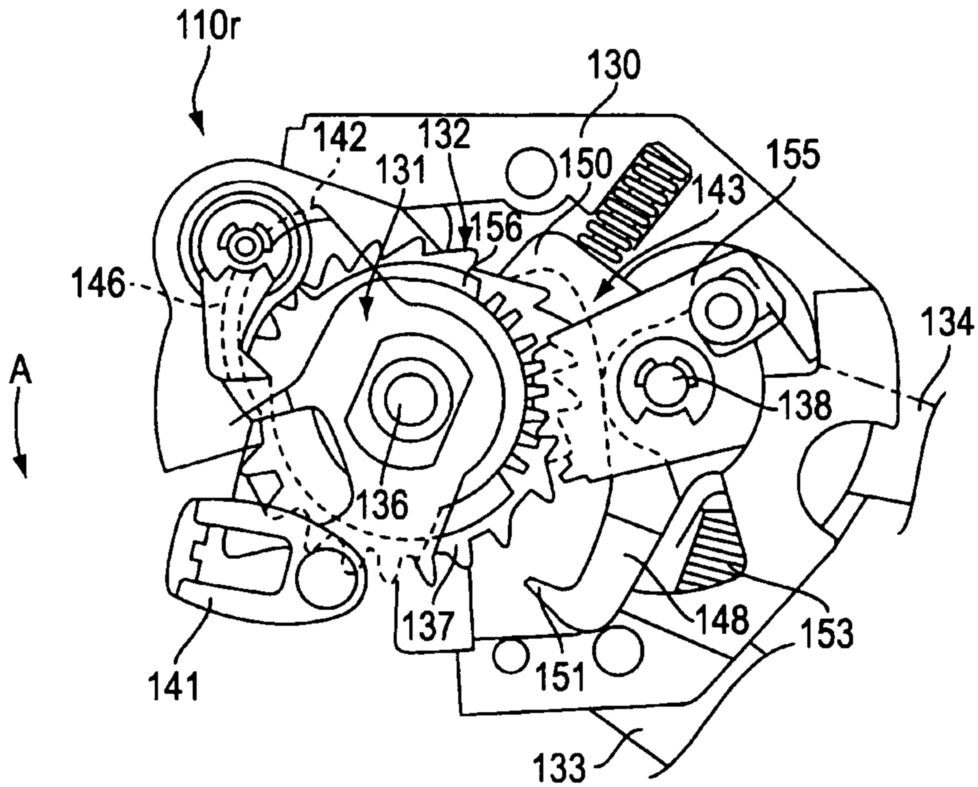


FIG. 16



121b
112
122
133
113
125b
145
110r
145a
130b
124a
B
123b
123a
124b
134
C
147
147a
121
130
130a
125a
121a

FIG. 17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133

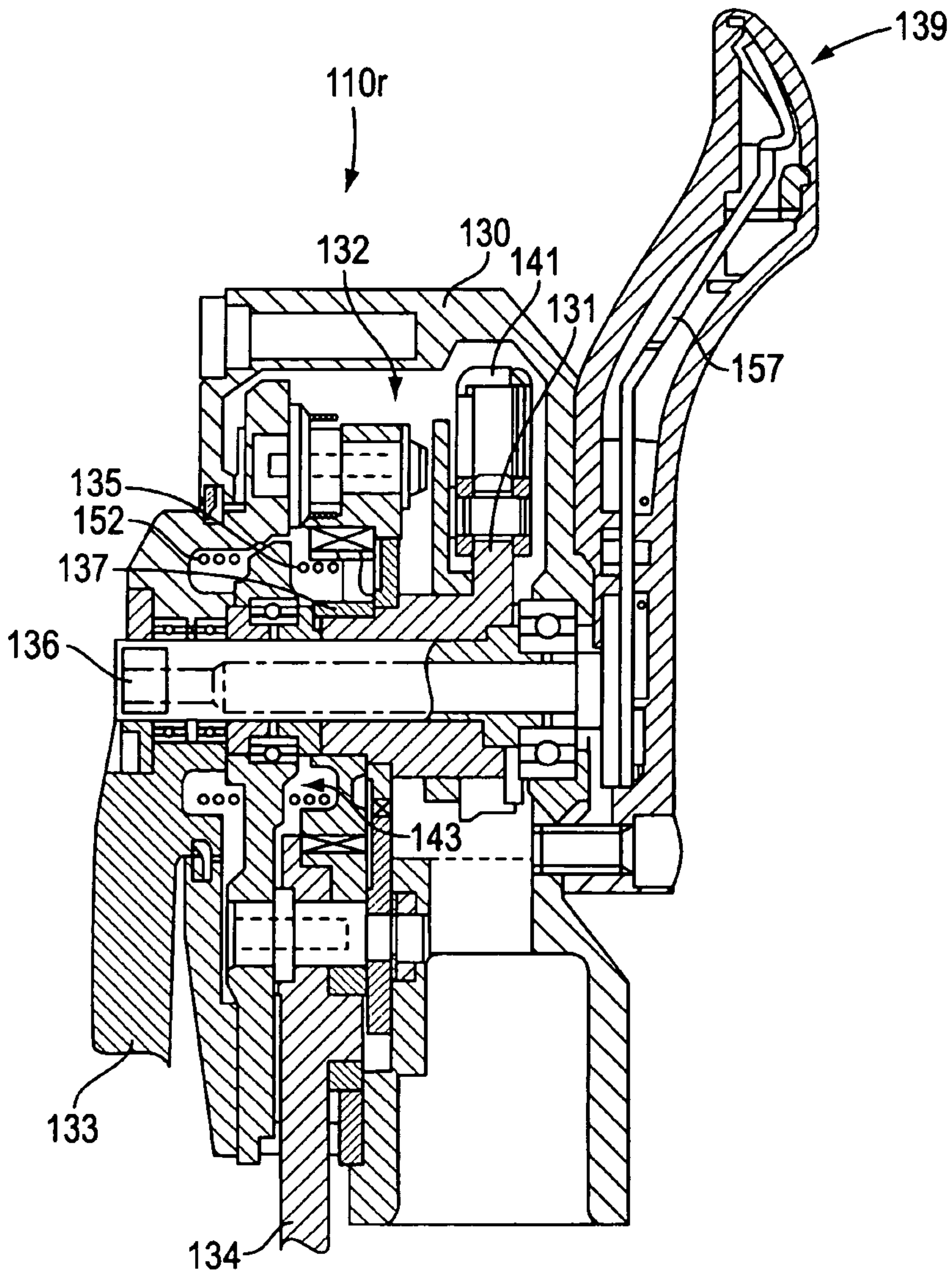
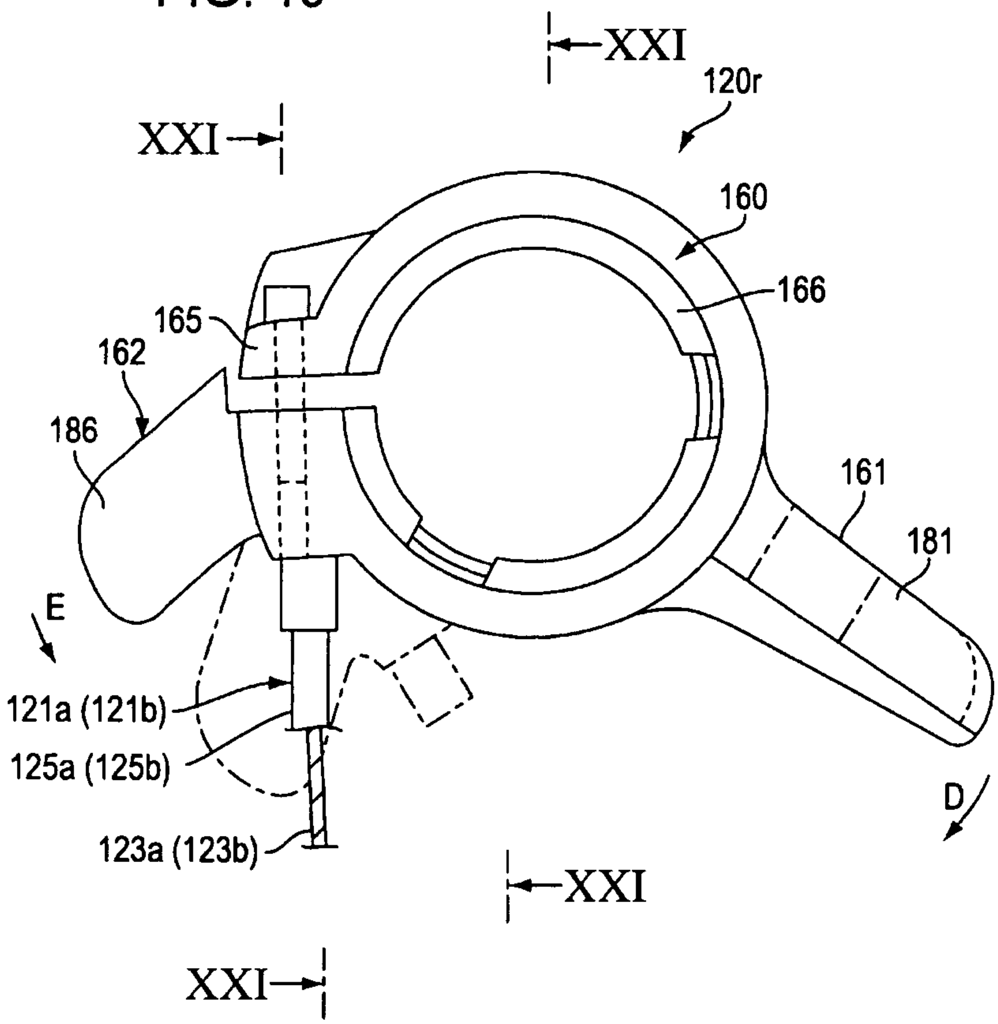


FIG. 18

FIG. 19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XXI
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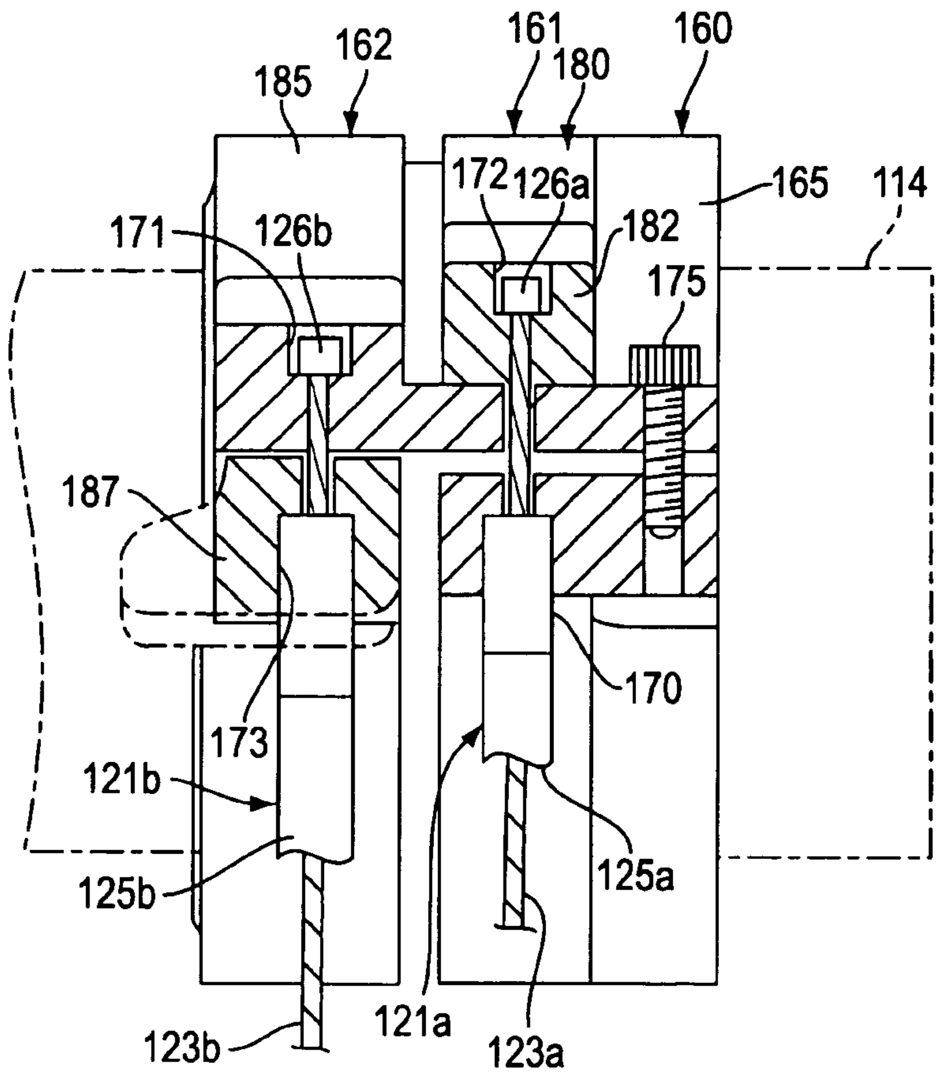
181
E
121a (121b)
125a (125b)
123a (123b)
D
XXI
XXI

FIG. 20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123a
123b

FIG. 21

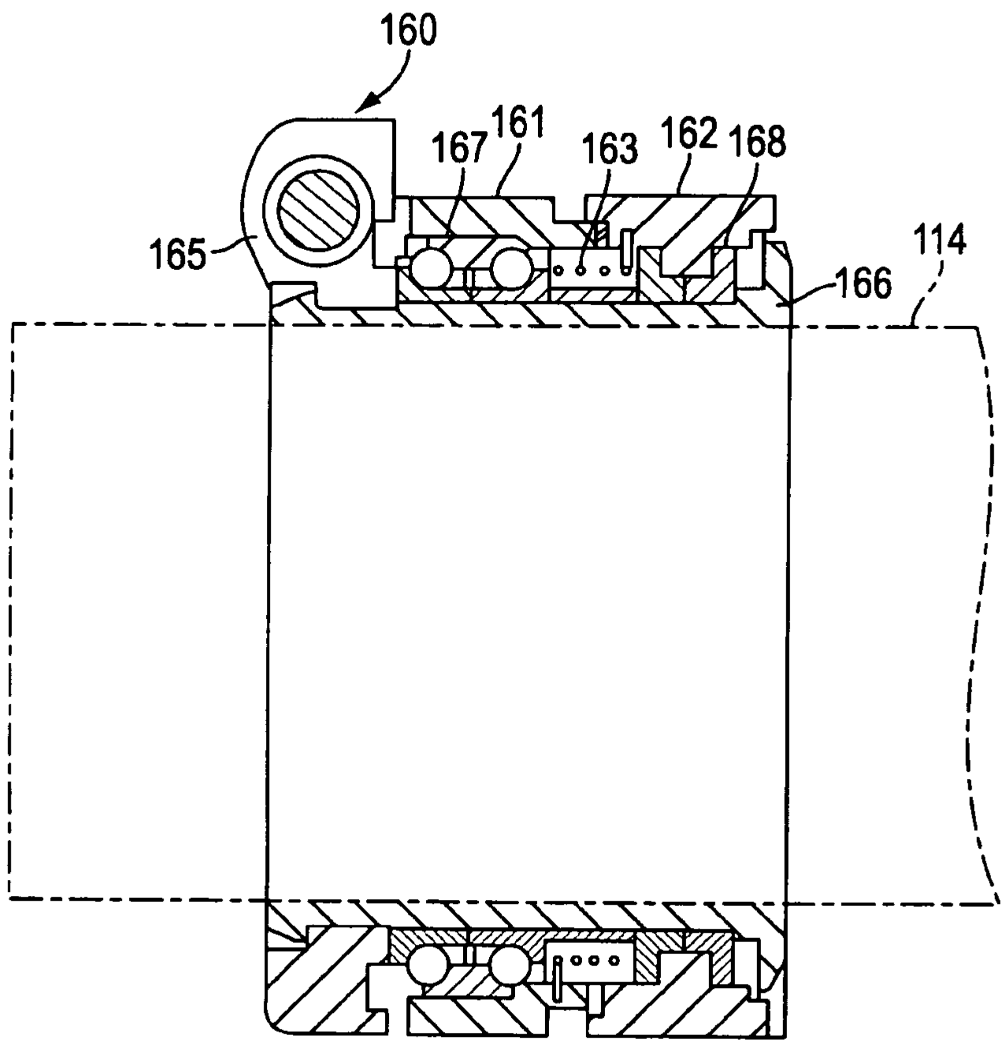

FIG. 22

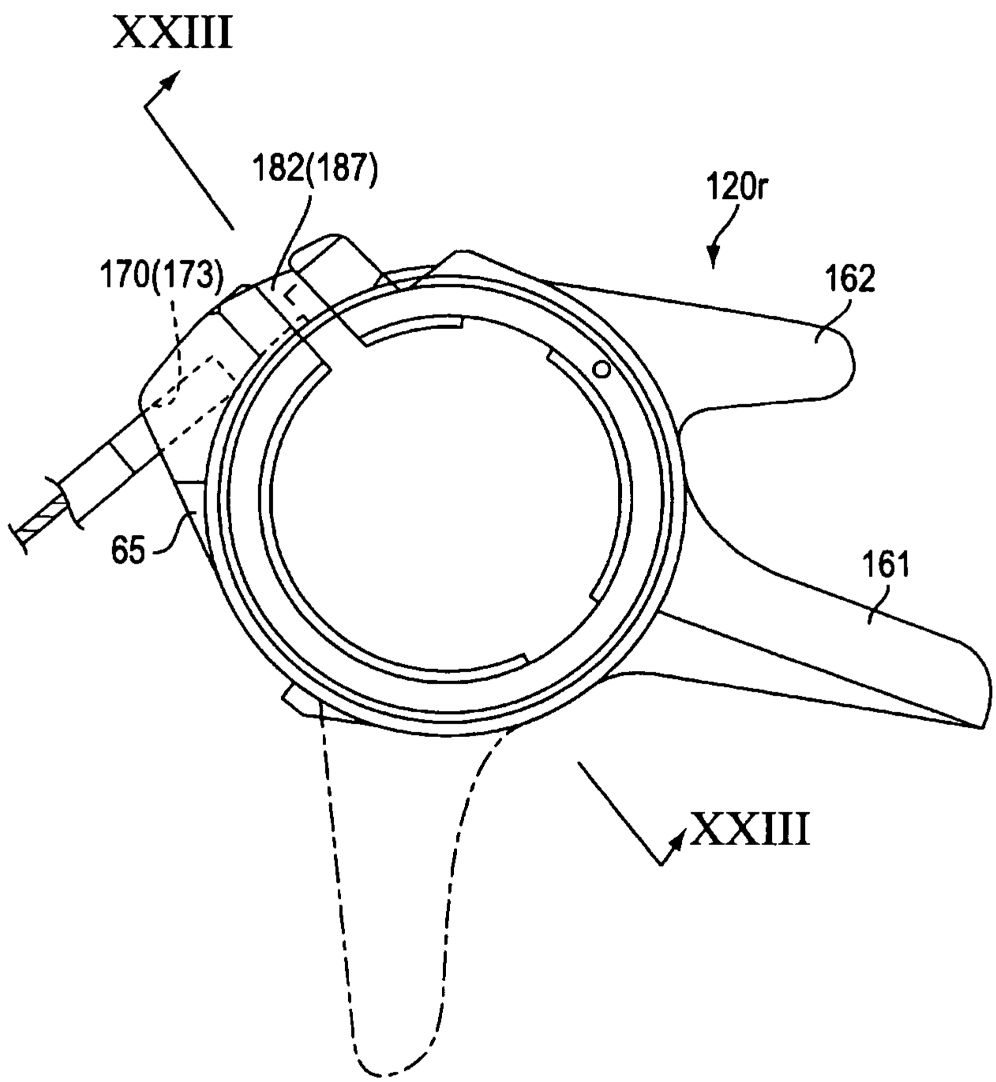

FIG. 23

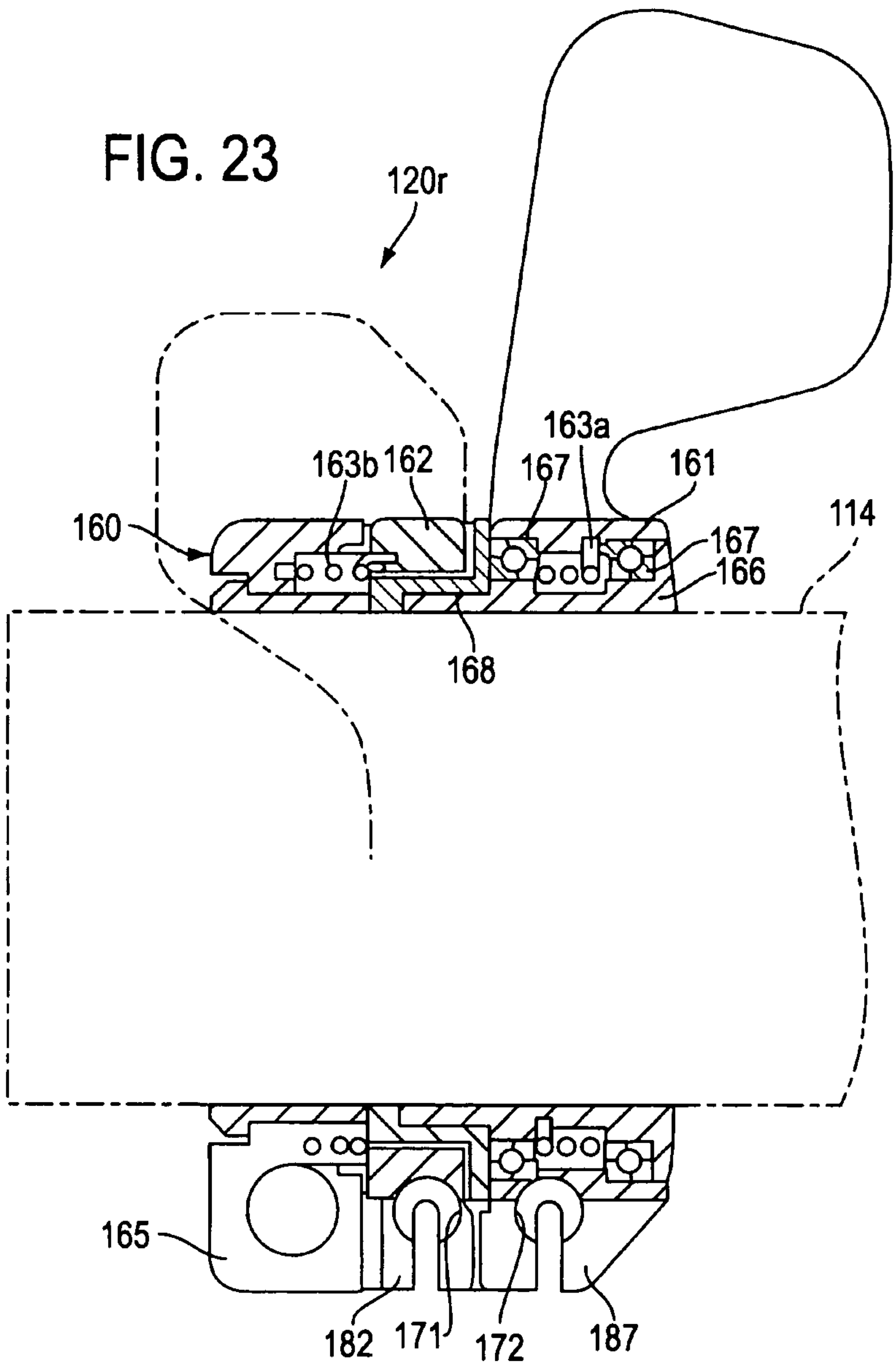
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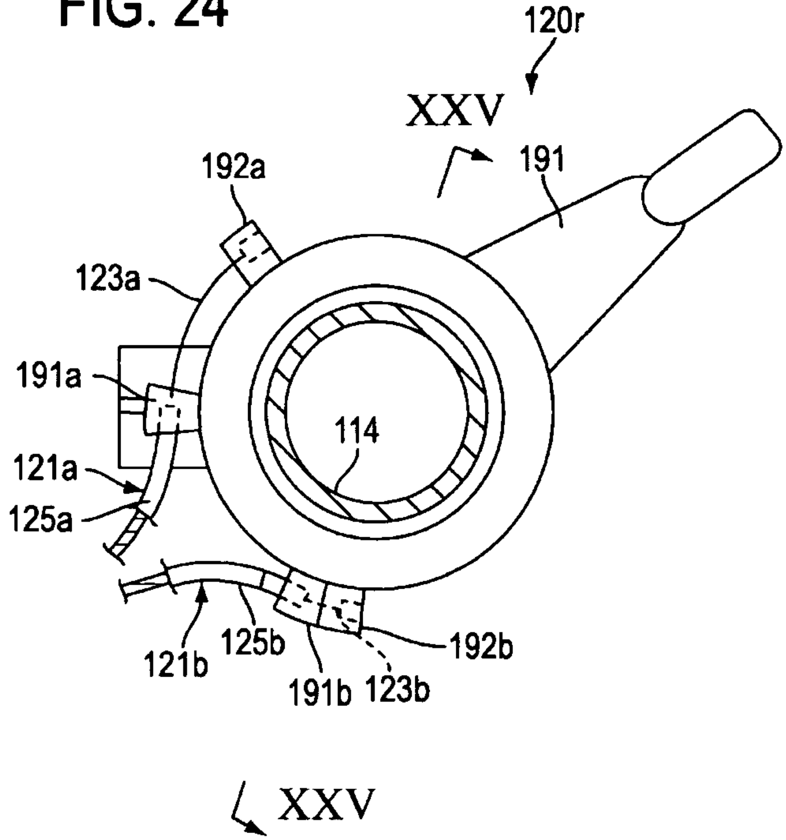
FIG. 24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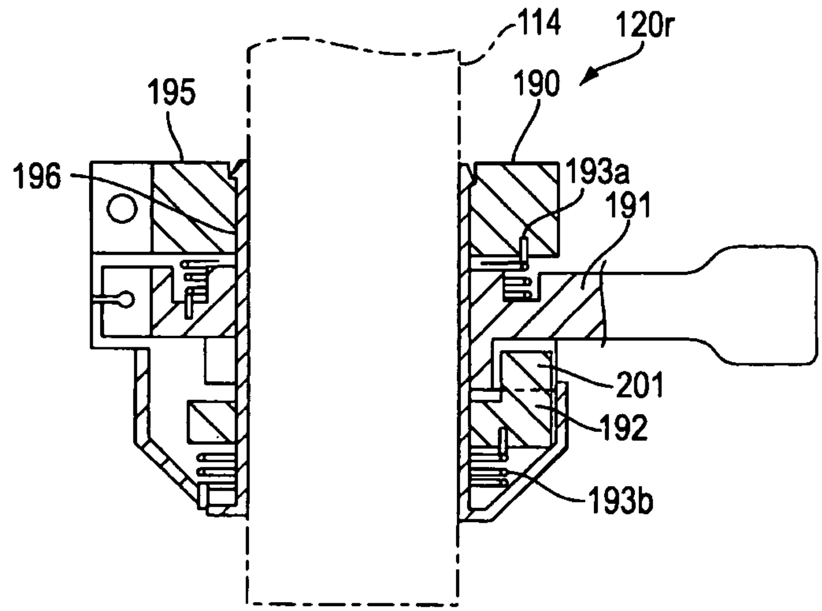
192b
XXV

FIG. 25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193a
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201
192
193b

FIG. 26

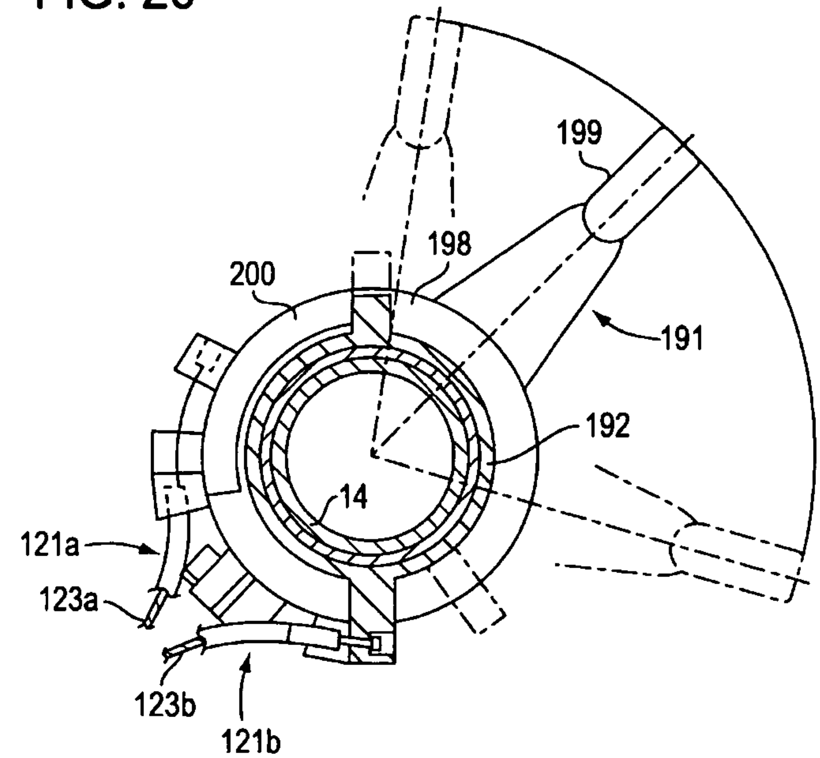
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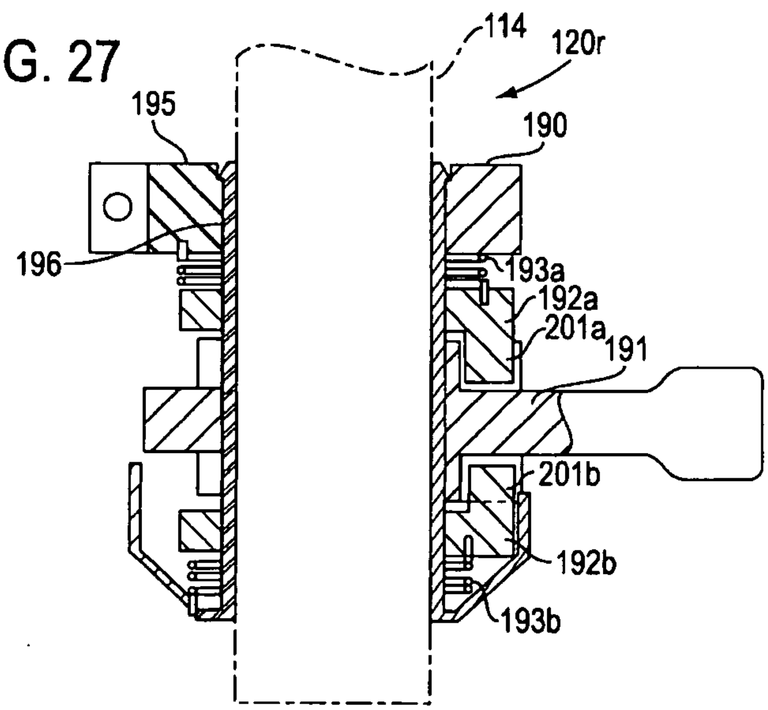
FIG. 27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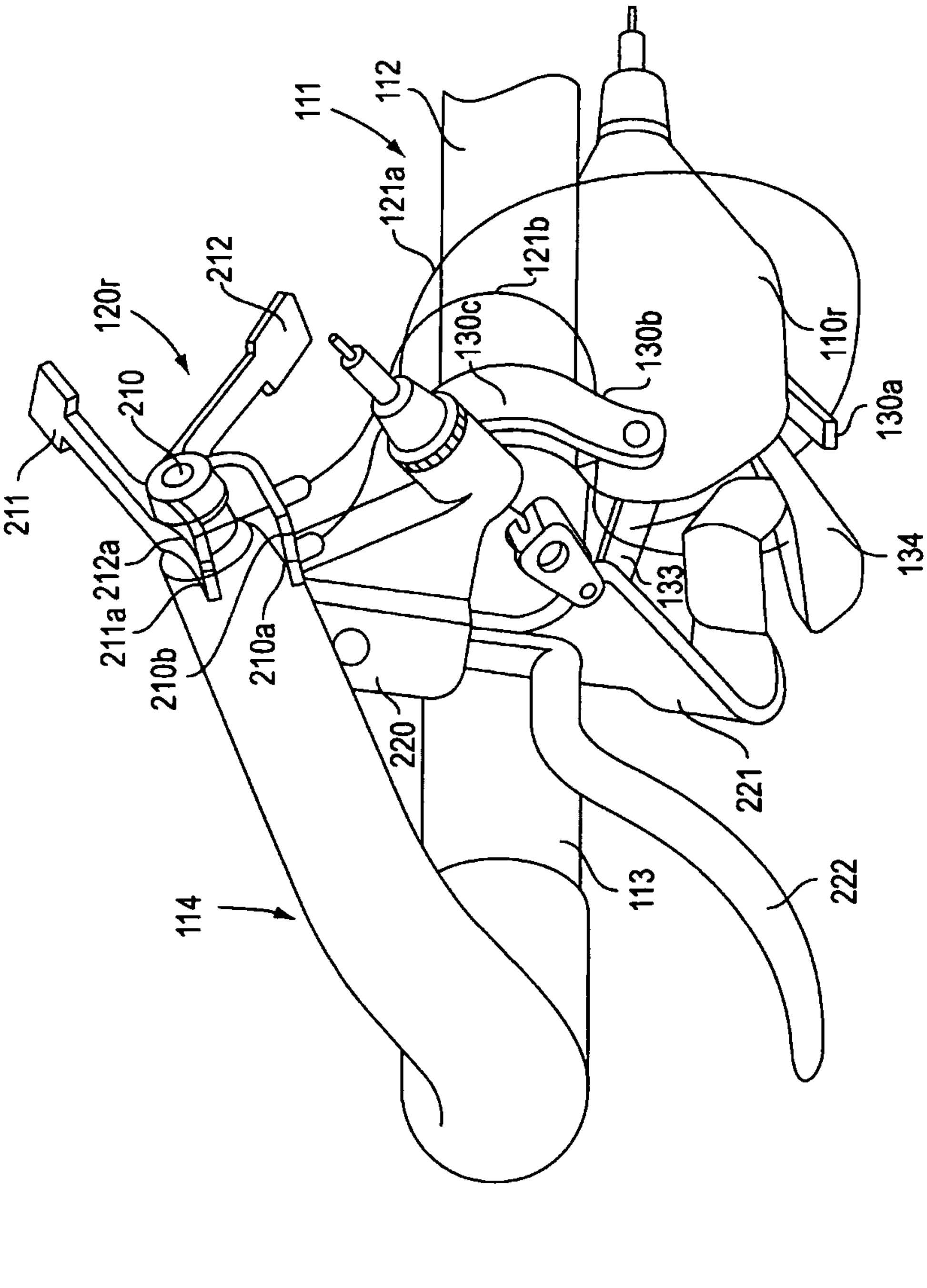
201a
191
201b
192b
193b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133
134
220
221
222
113
114

FIG. 28

BICYCLE SHIFTING APPARATUS HAVING REMOTELY LOCATED LEVERS FOR OPERATING A SINGLE TRANSMISSION

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of application Ser. No. 08/770,982, filed Dec. 20, 1996, now abandoned which is a continuation-in-part of application Ser. No. 08/579,931, filed Dec. 28, 1995, now abandoned.

BACKGROUND OF THE INVENTION

The present invention is directed to bicycle control devices and, more particularly, to a bicycle shifting apparatus having multiple remotely located levers for operating a single bicycle transmission.

Bicycles are typically equipped with a multistage front chain wheel in front and a multistage sprocket in the rear. These are connected by a chain, which provides rotational torque. The optimal gear ratio is selected, depending on the running speed, by selecting the multistage front chain wheel and multistage sprocket around which the chain is to be engaged. The shifting operations normally involve the operation of a shifting lever which can be operated from the grip position of the handle bars.

Many types of bicycle handle bars are shaped to provide for many different grip positions. For example, one position may be provided for riding at normal speed, and another position may be provided for riding at high speed, such as on hill roads, and usually designed to ward off wind resistance. Unfortunately, conventional shifting control devices are located only in a specific grip position. Thus, when the grip position is changed, it is not possible to control the shifting from the new position, making it necessary to move back to the original grip position in order to shift. Moving the hands back and forth and locating the proper grip positions wastes time and hinders high performance riding.

SUMMARY OF THE INVENTION

The present invention is directed to bicycle shifting control device which allows shifting to be accomplished from different positions on the handle bars (or other structural member of the bicycle). In one embodiment of the present invention, a first shifting control device is located at a first position on the bicycle, and a second shifting control device is located at a second position on the bicycle. The first shifting control device includes a first shifting lever for causing the first shifting control device to pull and release a first transmission element, and the second shifting control device includes a second shifting lever for causing the second shifting control device to pull and release a second transmission element. An interlocking mechanism interlocks the first shifting control device and the second shifting control device so that movement of either the first shifting lever or the second shifting lever causes the bicycle shifting control apparatus to shift the bicycle transmission.

Interlocking may be accomplished in a number of ways. In one specific embodiment, the interlocking mechanism comprises a connector for connecting the first transmission element and the second transmission element to the bicycle transmission. If desired, the connector may take the form of a joint for connecting the first transmission element and the second transmission element together and to a third transmission element so that the third transmission element may be connected to the bicycle transmission. In another specific

embodiment, the interlocking mechanism may comprise a connector for connecting the second transmission element to the first shifting lever so that movement of the first shifting lever causes a corresponding movement of the second transmission element. In yet another embodiment which may be applied to a first shifting control device of the type which has one lever for upshifting the bicycle transmission and another lever for downshifting the bicycle transmission, the second shifting control device may include one or two levers for controlling two transmission elements, wherein each transmission element is connected to one of the levers on the first shifting control device.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an oblique view of handle bars provided with a particular embodiment of a bicycle shifting control mechanism according to the present invention;

FIG. 2 is a front view depicting a particular embodiment of fixtures for fixing cables to the handle bars;

FIG. 3 is a cross sectional view of a particular embodiment of a shift control device shown in FIG. 1;

FIG. 4 is a partial cross sectional view of a shifting lever taken along line IV—IV in FIG. 3;

FIG. 5 is a plan view of a particular embodiment of a plate spring used in the shifting control device shown in FIG. 3;

FIG. 6 is a plan view of a particular embodiment of a position-determining plate used in the shifting control device shown in FIG. 3;

FIG. 7 is a plan view of a particular embodiment of a clamp used in the shifting control device shown in FIG. 3;

FIG. 8 depicts a particular embodiment of a structure for fixing the cables and wires of a corresponding pair of the shifting control devices shown in FIG. 1;

FIGS. 9A–9B depict an alternative embodiment of a structure for fixing the cables and wires of a corresponding pair of the shifting control devices shown in FIG. 1;

FIG. 10 is an oblique view of handle bars provided with an alternative embodiment of a bicycle shifting control mechanism according to the present invention;

FIG. 11 is a partial cross sectional view of a shifting lever similar to the shifting lever shown in FIG. 4, but with a particular embodiment of a cable connector according to the embodiment shown in FIG. 10;

FIG. 12 is a cross sectional view of a particular embodiment of a shift control device which may be used in the embodiment shown in FIG. 10;

FIG. 13 is an oblique view of handle bars provided with another alternative embodiment of a bicycle shifting control mechanism according to the present invention;

FIG. 14 is an oblique detailed view of the left side of the handlebar shown in FIG. 13;

FIG. 15 is a front view of a first shifting control device shown in FIG. 13;

FIG. 16 is a rear view of a first shifting control device shown in FIG. 13;

FIG. 17 is an internal view of the first shifting control device shown in FIG. 13;

FIG. 18 is an internal cross sectional view of the first shifting control device shown in FIG. 13;

FIG. 19 is a side view of a second shifting control device shown in FIG. 13;

FIG. 20 is a view taken along line XX—XX in FIG. 19;

FIG. 21 is a view taken along line XXI—XXI in FIG. 19;

FIG. 22 is a side view of an alternative embodiment of a second shifting control device which may be used with the first shifting control device shown in FIG. 13;

FIG. 23 is a view taken along line XXIII—XXIII in FIG. 22;

FIG. 24 is a side view of another alternative embodiment of a second shifting control device which may be used with the first shifting control de vice shown in FIG. 13;

FIG. 25 is a view taken along line XXV—XXV in FIG. 24;

FIG. 26 is a view illustrating the operation of the second shifting control device shown in FIG. 24;

FIG. 27 is a cross sectional view of another alternative embodiment of a second shifting control device similar to the device shown in FIG. 24; and

FIG. 28 is an oblique detail view of the right side portion of the handlebar for another alternative embodiment of a bicycle shifting control mechanism according to the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

FIGS. 1 and 2 show handle bars provided with a particular embodiment of a bicycle shifting control mechanism according to the present invention. In this embodiment, the handle bars 1 are handle bars for a mountain bike. A horizontally arranged stem component 2 is connected to a bicycle head pipe (not shown), and a cross component 4 is fixed to a stem bracket 3 at the end of the stem component 2. The cross component 4 is made of a metal pipe, both ends of which are bent at about a 90 degree angle. These parts constitute the side grips 5 and 6. Tubular synthetic resin grip members 7 and 8 are located on the cross component 4. These grip members 7 and 8 are gripped when the handle bars are operated during normal running for steering purposes.

A first front shifting control device 9 and a first rear shifting control device 10 are located transversely to the grip members 7 and 8. The first front shifting control device 9 is used to select a front chain wheel (not shown) for transferring the chain. More specifically, a first front shifting lever 24 in the first front shifting control device 9 is rotated to pull a wire 59 inside a cable 25 so as to drive and shift the front derailleur (not shown). The first rear shifting control device 10 is used to select one of the rear multistage sprockets (not shown). More specifically, a first rear shifting lever 11 in the first rear shifting control device 10 is rotated to pull a wire 14 in a cable 12 so as to drive the rear derailleur (not shown) and shift gears. The structure and function of the first rear shifting control device 10 is the same as the first front shifting control device 9 and thus will not be described in detail.

A second front shift control device 16 is located at the side grip component 5. This second front shifting control device 16 has essentially the same structure and function as the first front shifting control device 9, allowing front shifting to be controlled from this position as well. A second front shifting lever 26 in the second front shifting control device 16 is rotated to pull a wire 60 in a cable 27 so as to drive and shift the front derailleur (not shown). A second rear shifting control device 20 is located at the side grip component 6 on the same handle bars 1. The second rear shifting control device 20 has essentially the same structure and function as the first rear shifting control device 10, allowing rear shifting to be controlled from this position as well. A second rear shifting lever 22 in the second rear shifting control device 20 is rotated to pull a wire 13 in a cable 15 so as to drive and shift the rear derailleur (not shown).

The intermediate sections of the cables 15 and 27 are held by an annular cable clip 17. The cable clip 17 is fixed to the bottom of a plate-shaped anchoring metal fixture 18. The top of the anchoring metal fixture 18 is fixed with a nut 19 to one end of the corresponding grip member 7,8. A cable adjusting unit 21 is provided at the inlet of second rear shifting control device 20. This cable adjusting unit 21 is designed to fine tune the angle and position of the second rear shifting lever 22 by moving the outer casing 15 and the cable 13 inside in relation to each other. A similar cable adjusting unit 23 is provided at the inlet of second front shifting control unit 16.

FIG. 3 is a cross section depicting the interior of the first front shifting control device 9, and FIG. 4 is a partial cross section of the shifting lever when taken along line IV—IV in FIG. 3. As shown in FIG. 3, a pedestal 30 comprises the main body of the shifting control device and is fixed by a band member 31 to the cross component 4. One end of the band member 31 is established on the pedestal 30 so that it is rockable at a shaft 32, while the other end is fixed to the cross component 4 by a bolt 33.

A fixing bolt 34 is screwed into a screw hole 35 on the pedestal 30. A floor cover 36, a metal washer 37, and a plate spring 38 are fixed between the pedestal 30 and the fixing bolt 34. The floor cover 36 is a cover for the base, and the plate spring 38 is provided to push the position-determining ball 39 upward. The plate spring 38 is in the form of a disk, and ball-retaining holes 40 for determining the position of, and holding, the position-determining ball 39 are formed in the radial direction (see FIG. 5). The position-determining ball 39 can accordingly move only in the radial direction of the ball-retaining holes 40.

A position-determining plate 41 is arranged in the direction opposite the plate spring 38, with the position-determining ball 39 sandwiched between. The position-determining plate 41 is integrally fixed to the end face of a rotating cylinder member 42. Three position-determining holes 46 as well as position-determining holes 46 that differ from these by 180 degrees are formed in outer peripheral positions on the position-determining plate 41, for a total of six position-determining holes 46. Three position-determining holes 46 are located at the low L, middle M, and top T shifting ratios of the front shifting device. One position-determining ball 39 is inserted for these three position-determining holes 46, for a total of two position-determining balls 39 for all six holes. Friction components 47 in the form of rings are formed along the inside periphery of the position-determining holes 46 of the position-determining plate 41.

A clamp 50 is slidably and rotatably located on the cylindrical component 30*a* of the pedestal 30. Ball-retaining holes 51 are formed in the circumferential direction in the clamp 50. The position-determining balls 39 are held in the ball-retaining holes 51. The center position of the ball-retaining holes 51 expands in the radial direction. When the clamp 50 is rotated, the position-determining ball 39 in the ball-retaining hole 51 is thus moved in the radial direction and moves to the friction component 47 of the position-determining plate 41, where it is clamped. The rotating cylinder member 42 is slidably and rotatably located in part of the cylindrical part 30*a* of the pedestal 30.

A coiled return spring 43 is located between the rotating cylinder component 42 and the pedestal 30. One end of spring 43 is fixed to the rotating cylinder component 42, and the other end is fixed to the pedestal 30. The return spring 43

is energized in the direction counter to the energizing force of a return spring in the rear shifter (not shown), so as to equalize the torque needed to operate the first front shifting lever 24.

A wire-winding drum 44 is fixed along the outer periphery of the rotating cylinder component 42. A U-shaped concave part 45 is formed along the outer periphery of the wire-winding drum 44. As shown in FIG. 4, the distance in the radial direction of the concave component 45 varies depending on the angle and position. The first front shifting lever 24 is integrally provided on the wire-winding drum 44. This first front shifting lever 24 is rotated to allow the wire-winding drum 44 to be rotated. The concave component 45 of the wire-winding drum 44 is for winding the push-pull cable 59. Since the distance in the radial direction varies depending on the angle and position, the lever ratio varies according to the angle and position when the first front shifting lever 24 is operated.

To operate the first front shifting control device 9, the first front shifting lever 24 is operated so as to rotate the wire-winding drum 44. When the wire-winding drum 44 is thus rotated, the push-pull cable 59 is wound along the concave component 45, pulling the wire in the cable 25 and effecting the necessary shifting operation. When the wire-winding drum 44 is rotated, the integral rotating cylinder component 42 and position-determining plate 41 are also rotated with it at the same time. Although the position-determining ball 39 can move only in the radial direction by means of the ball-retaining hole 40, it is prevented from moving in the radial direction by means of the ball-retaining hole 51 of the clamp 50, so that it cannot move.

As a result of this rotation, the position-determining ball 39, which has stopped, is inserted into the next position-determining hole 46 of the position-determining plate 41, where it functions to determine position. That is, if the initial position is the low L position, the position of the first front shifting lever 24, winding drum 44, rotating cylinder component 42, and position-determining plate 41 moves to the next middle M position.

The following operations are done to execute this position determination in a non-stepwise manner. When the clamp 50 is rotated, the position-determining ball 39 is moved in the radial direction by the ball-retaining hole 51, allowing the ball to move to the friction component 47. The position-determining ball 39 fixes the position-determining plate 41 by means of the friction component 47. The position-determining plate 41 cannot be rotated, so the rotating cylinder component 42 can be fixed at a desired location.

The internal structure of the second front shifting control device 16 is the same as that of the first front shifting device 9 and thus will not be described in detail. Similarly, a detailed description will also be omitted for the internal structure of the first rear, shifting control device 10 and second rear shifting control device 20 since they are essentially the same, except for the different number of shifting stages. Alternatively, these shifting control devices may have another well-known structure.

FIG. 8 illustrates the method for fixing the cables and wires of the first and second front shifting control devices. A bracket 56 is welded and/or fixed by rivets to the vertical frame 55. Two cable support arms 57 protrude from the bracket 56. Tubular cable receivers 58 and 58 are integrally provided at the tip of each cable support arm 57. These cable receivers 58 are provided with floors. Holes through which wire is passed are opened in these floors, and cable caps for cables 25 and 27 are inserted into the cable receivers 58 to support them. One end each of the wire 59 of the cable 25 and of the wire 60 of the cable 27 is fixed to a front derailleur driving link 61. More specifically, one end of each of the wires 59 and 60 is inserted into the groove of a fixing plate 62, and the fixing plate 62 is fixed to the drive link 61 by a cable fixing bolt 63. Thus, when the first front shifting lever 24 or second front shifting lever 26 is operated, the drive link 61 constituting the four-node link mechanism of the front derailleur can be operated.

In this embodiment, when either of the first front shifting lever 24 or second front shifting lever 26 is operated, it is not possible to effect shifting with a shifting ratio higher than that because the drive link 61 cannot be returned, i.e., is in a pulled state, when either one of the shifting control devices is being operated. To avoid this, the lever that is not being used should be in the lowest shifting ratio, such as the low L position. Thus, for example, before the first front shifting lever 24 is operated, the second front shifting lever 26 should placed in the low L position initially. Thereafter, when the first front shifting lever 24 of the first front shifting control device 9 is operated, the wire 59 inside the cable 25 is pulled, driving the drive link 61. This, in turn, allows the front derailleur to be operated, transferring the sprocket chain (not shown) to effect shifting. The second front shifting lever 26 of the second front shifting control device 16 can be similarly operated, but in that case, the first front shifting lever 24 should initially be in the low L position.

FIGS. 9*a* and 9*b* are front and side cross sections of a second method for fixing the cables 59,60 to the front derailleur. As shown therein, two cable receivers, 65 are fixed by welding to the vertical frame 55, and holes are provided at the bottoms to pass wires through. Cable caps for the cables 25 and 27 are inserted into the cable receivers 65 and 65 to support them.

One end each of the wire 59 of the cable 25 and of the wire 60 of the cable 27 is connected to a joint 66. The joint 66 is further connected to one end of a wire 67, while the other end of the wire 67 is fixed to the drive link 61 that drives the front derailleur. The joint 66 is formed in the shape of a cylinder and is slidably inserted within a guide face 69 of a guide 68.

When the first front shifting lever 24 of the first front shifting control device 9 is operated, the wire 59 inside the cable 25 is pulled. When the wire 59 is thus pulled, the joint 66 is guided inside the guide 68, and the joint 66 is moved up and down. The up and down movement of this joint 66 pulls and releases the wire 67 for controlling drive link 61 and thus operating the front derailleur.

FIG. 10 is an oblique view of handle bars provided with an alternative embodiment of a bicycle shifting control mechanism according to the present invention. Structures which are the same as those shown in FIG. 1 are numbered the same. In this embodiment, one end of wire 13 of cable 15 is connected with a ball joint 72 to the intermediate section of the shifting control lever 11'. Similarly, one end of wire 60 of a cable 27 is connected with a ball joint 72 to the intermediate section of the shifting control lever 24'. The ball joint 72 is a well known structure in which a socket having a shape encompassing the spherical end of each wire 13,60 is fixed on the shifting control levers 11',24', thus allowing the wires 13,60 and the shifting control levers 11',24' to be connected no matter what the angle of the shifting control levers.

First front shift control device 9 and first rear shift control device 10 are constructed the same as in FIG. 1 with the exception of the provision of ball joint 72 on shift control

levers 11' and 24'. FIG. 11 is a cross section of first front shift control lever 11' showing the structure of ball joint 72. Furthermore, in this embodiment wire 59 is connected directly to the front derailleur, and wire 14 is connected directly to the rear derailleur.

FIG. 12 is a partial cross sectional view of a particular embodiment of second front shift control device 16'. Second rear shift control device 20' is constructed the same way. In this embodiment, shifting control lever 26' can be rocked, pivoting on a central shaft 23 in the center position of the interlocking lever case 20. One end of cable 60 is connected by means of a ball joint 72 to one end of the shifting control lever 26'. The other end of the shifting control lever 26' is provided with a tab 28 for manual operation that is bent in the shape of an L. As may be seen by the drawing, operating the shifting control lever 26' allows the cable 60 to be operated and allows the shifting control lever 26' to be interlocked with shifting control lever 24', so that shifting can be controlled by either the shifting control lever 26' or the shifting control lever 24'.

FIG. 13 is an oblique view of handle bars provided with another alternative embodiment of a bicycle shifting control mechanism according to the present invention. In FIG. 13, main shift control devices **110*f*** and **110*r*** pertaining to an embodiment of the present invention are mounted on both ends of a main bar **112** that extends to the left and right of a handlebar **111**. In addition to the main shift control devices **110*f*** and **110*r***, grips **113** are mounted to the outside thereof on the main bar **112**. Bar ends **114** that make up part of the handlebar **111** are mounted to the outside of the grips **113**. The bar ends **114** are mounted facing forward and upward on the ends of the main bar **112**. The main bar **112** is attached to the distal end of a stem **118**. The base end of the stem **118** is mounted to the upper end of a suspension fork **115** such that it sandwiches the head component **117** at the distal end of a bicycle frame **116**.

Auxiliary shift control devices **120*f*** and **120*r*** that are used for the remote operation of the front and rear main shift control devices **110*f*** and **110*r*** are mounted to the distal ends of the bar ends **114**. These auxiliary shift control devices **120*f*** and **120*r*** are linked to the main shift control devices **110*f*** and **110*r*** by two control cables **121*a*** and **121*b***, respectively.

As shown in FIGS. 14 through 16, the main shift control devices **110*f*** and **110*r*** are integrated with brake levers **121**, and they are mounted underneath the main bar **112** via brake brackets **122** that swingably support the brake levers **121**. The main shift control device **110*r***, which is used for rear shifts, will be described below.

As shown in FIGS. 15 through 18, the main shift control device **110*r*** comprises a main control bracket **130** that is formed integrally with a brake bracket **122**; a winder **131** that is positioned in the interior of the main control bracket **130** and is rotatably supported by the main control bracket **130**; a positioning mechanism **132** for setting the rotational position of the winder **131** in stages; a first shift lever **133** that is used to operate the winder **131** rotationally; a release mechanism **143** for releasing the setting of the rotational position of the winder **131**; and a torsion coil spring **135** for energizing the winder **131** in the opposite direction from the winding direction. The main shift control device **110*r*** also has a display **130** for displaying the rotational position.

The winder **131** has a shift cable stopping component **141** that is used to stop the inner cable **140*a*** of a shift cable (FIG. 14) connected to a rear derailleur (not shown). The winder **131** also has around its periphery a cable guide **142** that guides the wound inner cable **140*a***. The winder **131** is fixed to a rotating shaft **136** rotatably supported by a bearing on the main control bracket **130**. Also fixed to the winder **131** is a shift gear **137** that constitutes the positioning mechanism **132** and on the peripheral surface of which are formed serrated feed teeth and positioning teeth.

The first shift lever **133** is rotatably mounted to the rotating shaft **136**. The first shift lever **133** is energized in the opposite direction from the operation direction by a torsion coil spring **152**. A control component **145** is formed at the distal end of the first shift lever **133**. A feed pawl **146** is rotatably mounted at a point where the first shift lever **133** is positioned inside the main control bracket **130**. The feed pawl **146** is energized such that its distal end can come into contact with the feed teeth of the shift gear **137**. When this first shift lever **133** is rotated in the direction of arrow A in FIG. 17, the feed pawl **146** engages with the feed teeth, the shift gear **137** is engaged, and the winder **131** is rotated in the winding direction.

The second shift lever **134** has a control component **147** on its distal end. The second shift lever **134** is energized in the opposite direction from the operation direction by a spring **153**. The second shift lever **134** is rotatably supported on a rotating shaft **138** embedded in the main control bracket **130**. A release pawl **150** and a positioning pawl **151**, which are actuated in conjunction with the second shift lever **134**, and which constitute the release mechanism **143**, are provided at the rotational center of the second shift lever **134**. The release pawl **150** and positioning pawl **151** position the winder **131** by selectively stopping the positioning teeth formed on the peripheral surface of the shift gear **137**. The release pawl **150** is energized in the direction of the shift gear **137** by a spring **154**, the state of stoppage to the shift gear **137** is released by rotational actuation of the second shift lever **134**, and the positioning pawl **151** is stopped to the shift gear **137** simultaneously with this release. When the second shift lever **134** returns to its original position as a result of its energization by the spring **152**, the release pawl **150** is stopped to the positioning teeth of the shift gear **137**, and the winder **131** is positioned in a state in which the inner cable has been played out by one tooth of the positioning teeth. The positioning pawl **151** comes out at this point.

A feed pawl release mechanism **155** that works in conjunction with the second shift lever **134** is provided at the rotational center of the second shift lever **134**. The feed pawl release mechanism **155** rotates a feed pawl release gear **156**, which is rotatably supported on the rotating shaft **136**, according to the rotation of the second shift lever **134**, and rotates the feed pawl **146** to the position where it disengages from the shift gear **137**.

The first shift lever **133** and second shift lever **134** rotate in opposite directions from one another. Specifically, in FIG. 16, the first shift lever **133** rotates in the direction of arrow B, while the second shift lever **134** rotates in the direction of arrow C. The positions after this rotation are close to each other. Inner cable stopping components **145*a*** and **147*a*** that stop the inner cables **123*a*** and **123*b*** of the control cables **121*a*** and **121*b*** are provided to the control component **145** of the first shift lever **133** and the control component **147** of the second shift lever **134**, respectively. The inner cable stopping components **145*a*** and **147*a*** are designed to stop drums **124*a*** and **124*b*** fixed to the distal ends of the inner cables **123*a*** and **123*b***. Outer stopping components **130*a*** and **130*b***, which are used to stop the outer casings **125*a*** and **125*b*** of the control cables **121*a*** and **121*b***, are provided to the main control bracket **130**. The outer stopping component **130*a*** is provided to the lower portion of the main control bracket

130 in FIG. 16, and the outer stopping component 130*b* is formed at the boundary between the brake bracket 122 and the main control bracket 130.

A display 139 has an indicator needle 157 mounted at the distal end of the rotating shaft 136. The indicator needle 157 is linked to one end of the rotating shaft 136, and rotates to display the shift position.

The auxiliary shift control devices 120*f* and 120*r* will now be described. The following description will be for the auxiliary shift control device 120*r* linked to the main shift control device 110*r* for rear shifting.

As shown in FIGS. 19 to 21, the auxiliary shift control device 120*r* comprises an auxiliary control bracket 160 mounted to the distal end of the bar end 114 that makes up part of the handlebar 111, a first auxiliary shift lever 161 rotatably supported by the auxiliary control bracket 160, a second auxiliary shift lever 162 rotatably supported by the auxiliary control bracket 160 next to the first auxiliary shift lever 161, and a torsion coil spring 163 that is used to return these auxiliary shift levers 161 and 162 to specific positions.

The auxiliary control bracket 160 has a ring-shaped fastening component 165 that has a groove formed in its radial direction, and a tube 166 that is fixed to the bar end 114 by the fastening component 165. A bearing 167 is installed around the outer periphery of the tube 166, and the first auxiliary shift lever 161 is rotatably supported via this bearing 167. A bushing 168 is installed around the outer periphery of the tube 166 at a distance from the bearing 167 in the axial direction, and the second auxiliary shift lever 162 is rotatably supported by the bushing 168. A return-use torsion coil spring 163 is installed in a twisted state between the bearing 167 and the bushing 168. One end of the torsion coil spring 130 is stopped by the first auxiliary shift lever 161, and the other end is stopped by the second auxiliary shift lever 162. As a result, the first auxiliary shift lever 161 and the second auxiliary shift lever 162 are energized in opposite directions from one another (the play-out directions of the inner cables 123*a* and 123*b*). Here, since the two auxiliary shift levers 161 and 162 rotate in opposite directions, a single torsion coil spring 163 can serve as the two energization means for energizing the two levers 161 and 162.

As shown in FIG. 20, an outer stopping component 170 and an inner stopping component 171 that extend in the axial direction of the bar end 114 are formed in the fastening component 165. The outer stopping component 170 stops the distal end of the outer casing 125*a* of the control cable 121*a*. The inner cable 123*a* of this control cable 121*a* is stopped by an inner stopping component 172 formed on the peripheral surface of the first auxiliary shift lever 161. The inner stopping component 171 stops the drum 126*b* at the distal end of the inner cable 123*b* of the control cable 121*b*. The outer casing 125*b* of this control cable 121*b* is stopped by an outer stopping component 173 provided to the second auxiliary shift lever 162. The fastening component 165 is fastened to the bar end 114 by a fastening bolt 175.

The first auxiliary shift lever 161 has a ring component 180 and an auxiliary control component 181 that extends outward from the ring component 180 in the radial direction. A stopper 182 that strikes the fastening component 165 is provided to the outer peripheral surface of this ring component 180 such that it protrudes outward, and the inner stopping component 172 is formed at this stopper 182. This first auxiliary shift lever 161 is energized by the torsion coil spring 163 and is always disposed at the location where the stopper 182 strikes the fastening component 165.

The second auxiliary shift lever 162 has a ring component 185 and an auxiliary control component 186 that extends outward from the ring component 185 in the approximate radial direction. The auxiliary control component 186 is formed on the opposite side from the auxiliary control component 181 with respect to the axial center. A stopper 187 is formed at the base of the auxiliary control component 186. The stopper 187 strikes the fastening component 165. The outer stopping component 173 is formed in this stopper 187. This second auxiliary shift lever 162 is energized by the torsion coil spring 163 and is always disposed at the location where the stopper 187 strikes the fastening component 165.

The actuation during a shift will now be described.

When the first shift lever 133 of the main shift control devices 110*r* and 110*f* is rotationally operated in the direction of arrow B in FIG. 16 (downward) by the thumb, for example, the winder 131 is rotated in the winding direction (the direction of arrow A in FIG. 17) by the feed pawl 146. As a result, the inner cable 140*a* of the shift cable 140 is pulled, and the front derailleur or rear moves upward, for example. In the case of a front derailleur, the chain guide of the front derailleur moves from a smaller diameter gear toward a larger diameter gear and from the inner cable toward the outer casing. In the case of a rear derailleur, chain guide of the rear derailleur moves from a smaller diameter gear toward a larger diameter gear and from the outer casing toward the inner cable. When the feed pawl 146 moves the winder 131, the release pawl 150 restricts the rotation of the winder 131 in the line play-out direction at the point when the rotation comes to a halt, while stopping the positioning teeth of the shift gear 137 by one tooth at a time. The winder 131 is positioned rotationally by one stage at a time by this release pawl 150.

Meanwhile, when the first auxiliary shift lever 161 of the auxiliary shift control devices 120*f* and 120*r* is rotationally operated in the direction of arrow D) in FIG. 19 by the thumb, for example, the inner cable 123*a* of the control cable 121*a* is pulled and moves in the direction of arrow B in FIG. 16, just as when the first shift lever 133 was operated by the thumb. As a result, the inner cable 140*a* of the shift cable 140 is pulled in the same manner as that described above.

When the second shift lever 134 is rotationally operated in the direction of arrow C by the index finger, for example, the release pawl 150 retracts from the shift gear 137, and at the same time the positioning pawl 151 strikes the shift gear 137. As a result, the winder 131 is halted in a state in which it has rotated slightly in the line play-out direction. At this point, the feed pawl 146 is also retracted from the shift gear 137 by the feed pawl release mechanism 154. When the second shift lever 134 is returned to its home position by the spring 152 in this state, the positioning pawl 151 retracts from the shift gear 137, the release pawl 150* is stopped by the tooth on the upstream side in the line play-out direction of the shift gear 137, and the winder 131 rotates by one tooth in the line play-out direction. As a result, the inner cable 140*a* of the control cable 140 is played out by one shift step, and the derailleur moves downward. In the case of a front derailleur, for instance, the chain guide moves from a larger gear to a smaller gear and from the outer casing to the inner cable, and in the case of a rear derailleur, the chain guide moves from a larger gear to a smaller gear and from the inner cable to the outer casing.

Meanwhile, when the second auxiliary shift lever 162 of the auxiliary shift control devices 120*f* and 120*r* is operated in the direction of arrow E in FIG. 19 by the index finger, for example, the outer casing 125*b* of the control cable 121*b* is

pushed, and the inner cable **123***b* is relatively pulled. As a result, the second shift lever **134** rotates in the direction of arrow C in FIG. **16**, the inner cable **140***a* of the shift cable **140** is played out by the above actuation, and a downshift is made.

Here, the shift control can be performed by either of the main shift control devices **110***f* and **110***r* and auxiliary shift control devices **120***f* and **120***r*. Furthermore, either of the shift control devices can be used to make a shift by repeating the same actuation from a given position, regardless of the shift step. Therefore, shift control can be performed easily and reliably from two handle positions.

In the above embodiment, the auxiliary shift levers of the auxiliary shift control device were rotated in a different directions, but they may also be rotated in the same direction, as shown in FIGS. **22** and **23**. The routing of the control cables **121***a* and **121***b* is easier in this case.

In this embodiment, the auxiliary shift control device **120***r* has an auxiliary control bracket **160**, a first auxiliary shift lever **161**, a second auxiliary shift lever **162**, a first torsion coil spring **163***a* that is used to return the first auxiliary shift lever **161** to a specific rotational position, and a second torsion coil spring **163***b* that is used to return the second auxiliary shift lever **162** to a specific rotational position. The auxiliary control bracket **160** has a fastening component **165** and a tube **166** that is fastened by the fastening component **165**. A bearing **167** is disposed at a distance on the outer peripheral side of the tube **166**, and the first auxiliary shift lever **161** is rotatably supported on the tube **166** by this bearing **167**. A bushing **168** is disposed at a distance from the bearing **167** on the outer peripheral side of the tube **166**, and the second auxiliary shift lever **162** is rotatably supported on the tube **166** by this bushing **168**.

With this structure, the first auxiliary shift lever **161** and the second auxiliary shift lever **162** are provided with stoppers **182** and **187**, respectively, that each strike the fastening component **165**, and these stoppers **182** and **187** are provided with the inner stopping components **171** and **172** that stop the inner cables **123***a* and **123***b* of the control cables **121***a* and **121***b*. The fastening component **165** is provided with two outer casing stopping components **170** and **173** that stop the outer casings **125***a* and **125***b*, respectively.

With a structure such as this, when the first auxiliary shift lever **161** is rotationally operated downward as shown by a broken line in FIG. **22**, the first shift lever **133** rotates via the control cable **121***a*, and an upshift is made. Conversely, when the second auxiliary shift lever **162** is rotationally operated downward, the control cable **121***b* is operated, the second shift lever **134** is operated, and a downshift is made.

With the above embodiment, a shift was made in the auxiliary shift control device by means of two auxiliary shift levers, but in the following embodiment, the shift control is performed with a single auxiliary shift lever. As shown in FIGS. **24** to **26**, this auxiliary shift control device **120***r* has a main control bracket **190**, an auxiliary shift lever **191** that is rotatably supported on the main control bracket **190**, a rotary member **192** that only rotates in conjunction with the rotation of the auxiliary shift lever **191** in one direction, a first torsion coil spring **193***a* that returns the auxiliary shift lever **191** to a specific position, and a second torsion coil spring **193***b* that returns the rotary member **192** to a specific position. The main control bracket **190** has a fastening component **195** and a tube **196** that is fastened by the fastening component **195**. The lower end of the tube **196** in FIG. **25** is formed so as to cover the rotary member **192**. The fastening component **195** has outer casing stopping components **191***a* and **191***b* that stop the outer casings of the two control cables **121***a* and **121***b*. The auxiliary shift lever **191** has an inner cable stopping component **192***a* that stops the distal end of the inner cable **123***a* of the control cable **121***a*. This inner cable stopping component **192***a* also functions as a stopper that strikes the fastening component **195**. The rotary member **192** has an inner cable stopping component **192***b* that stops the distal end of the inner cable **123***b* of the control cable **123***b*. This inner cable stopping component **192***b* also functions as a stopper that strikes the fastening component **195**.

The auxiliary shift lever **191** has a ring component **198** that is rotatably supported on the tube **196**, and a control component **199** that extends from the ring component **198** in the radial direction. An engagement component **200** that is sunken lower than the other portions during a specific angle in the peripheral direction is formed on the rotary member **192** side of the ring component **198**. An engagement protrusion **201** is formed around the outer periphery of the rotary member **192** toward this engagement component **200**. As a result of the engagement of the engagement protrusion **201** and the engagement component **200**, the range of rotation of the rotary member **192** is restricted, the rotary member **192** is energized at a specific position by the second torsion coil spring **193***b*, and further rotation is prohibited by the stopper, so the rotary member **192** only rotates in conjunction with the counterclockwise rotation (in FIG. **26**) of the auxiliary shift lever **191**, and does not rotate in conjunction with clockwise rotation.

With a structure such as this, when the auxiliary shift lever **191** is rotated clockwise from the specific position indicated by the solid lines in the figure, the rotary member **192** does not rotate, and only the auxiliary shift lever **191** rotates clockwise. As a result, the inner cable **123***a* of the control cable **121***a* is pulled and the first shift lever **133** is actuated. Conversely, when the auxiliary shift lever **191** is rotated counterclockwise from the specific position indicated by the solid lines, the inner cable **123***a*just goes slack and is not pulled, and the rotary member **192** rotates counterclockwise in conjunction with the rotation of the auxiliary shift lever **191**. As a result, the inner cable **123***b* of the control cable **121***b* is pulled and the second shift lever **134** is actuated. With a structure such as this, an upshift or downshift can be made according to the rotational direction of the single control lever, so a shift can be made easily and reliably.

In the above embodiment, the design was such that the control cable **121***a* was stopped by the auxiliary shift lever **191**, but as shown in FIG. **27**, two rotary members **192***a* and **192***b* may be provided, one on either side of the auxiliary shift lever **191**, and the control cables **121***a* and **121***b* may be stopped by the rotary members **192***a* and **192***b*, respectively. In this case, the auxiliary shift lever **191** rotates in both directions, but the rotary member **192***a* only follows this rotation in one direction of the auxiliary shift lever **191**, and the rotary member **192***b* only follows the rotation in the other direction of the auxiliary shift lever **191**. The two rotary members **192***a* and **192***b* are energized in opposite directions by the torsion coil spring **193***a* and **193***b*. Again in this embodiment, a shift can be made easily and reliably since an upshift or downshift can be made according to the rotational direction of the single control lever.

In the above embodiment, the brake lever **121** was only provided to the main bar **112**, so shift control could not be performed on the bar end **114** side, but as shown in FIG. **28**, the main shift control device **110***r* may be separate from the brake lever **222**, and the brake lever **222** may be mounted at

the distal end of the bar end **114**. Also, the auxiliary shift control device **120r** may be mounted directly at the distal end of the bar end **114**.

In FIG. **28**, the main shift control device **110r** comprises a main control bracket **130c** and a first shift lever **133** and second shift lever **134** that are rotatably supported inside the main control bracket **130c**. The main control bracket **130c** is provided with outer casing stopping components **130a** and **130b** that stop the outer casings of the two control cables **121a** and **121b**. The rest of the structure is the same as that in the main shift control device described above, and as such will not be described here.

The auxiliary shift control device **120r** has a rotary bracket **210** fixed to the distal end of the bar end **114**, and a first auxiliary shift lever **211** and second auxiliary shift lever **212** that are rotatably supported by the rotary bracket **210**. The first auxiliary shift lever **211** and second auxiliary shift lever **212** each can be returned to a specific position by a spring (not shown), and the rotational operation thereof begins from this specific position. The first auxiliary shift lever **211** and second auxiliary shift lever **212** are provided with inner cable stopping components **211a** and **212a**, respectively. The auxiliary control bracket **210** is provided with outer casing stopping components **210a** and **210b**.

Meanwhile, a brake bracket **220** and the bar end **114** are mounted integrally or separately to the distal end of the bar end **114**. A first brake lever **221** that extends to the grip **113** side, and a second brake lever **222** that extends along the bar end **114**, are integrally and rotatably supported by the brake bracket **220**. With a structure such as this, shift control and braking control can both be performed with the bar end **114**, so shift control and braking control can both be performed easily and reliably from two handle positions.

While the above is a description of various embodiments of the present invention, further modifications may be employed without departing from the spirit and scope of the present invention. For example, the first and second front shifting control devices **9** and **16** in the embodiments disclosed in FIGS. **1–12** were types in which wires are driven by shifting levers, and these wires are returned by the same shifting levers. These front shifting control devices **9** and **16**, however, may have another well-known structure not of this type, in which a ratchet mechanism is internally installed, and in which the wires are transported and driven by the shifting levers but are stopped by the ratchet mechanism, with a release lever provided to disconnect this engagement. The first rear shifting control device **10** and second rear shifting control device **20** may also have another structure and function. Although the shifting levers did not return to the operating positions in the aforementioned first and second front shifting control devices **9** and **16**, they may be types that do return to the original position every time they are operated.

Although the interlocking of the shifting control device **11** and shifting control device **22** was effected with the cable **13** in the embodiments described in FIGS. **1–12**, it may also be effected by another method, such as where the wire-winding drum **44** and the shifting control lever **22** are interlocked by a rod, or where a winding drum (no wire) driven by a shift control lever **22** and the wire-winding drum **44** are interlocked with a rod or push-pull cable.

The same kinds of modifications also could be applied to the embodiments shown in FIGS. **13–28**. Furthermore, in the embodiments shown in FIGS. **13–28**, the auxiliary shift control devices **120f** and **120r** were mounted to the bar end **114** of a mountain bike, but the present invention is not limited to this, and the auxiliary shift control devices may instead be mounted to the DH bar (also known as an aero bar) of a road bike. Also, the auxiliary shift control devices **120f** and **120r** were mounted to the bar end **114**, and the main shift control devices **110f** and **110r** were mounted to the main bar **112**, but the present invention is not limited to this, and the main shift control devices **110f** and **110r** may instead be mounted to the bar end **114**, and the auxiliary shift control devices **120f** and **120r** to the main bar **112**.

Thus, the scope of the invention should not be limited by the specific structures disclosed. Instead, the true scope of the invention should be determined by the following claims. Of course, although labeling symbols are used in the claims in order to facilitate reference to the figures, the present invention is not intended to be limited to the constructions in the appended figures by such labeling.

What is claimed is:

1. A bicycle shifting control apparatus for a bicycle transmission, the apparatus comprising:
 - a first shifting control device (**9,10,110f,110r**) located at a first position on the bicycle, the first shifting control device including a first rotating member (**24,11,133, 134**) for causing the first shifting control device (**9,10, 110f,110r**) to operate a first transmission element (**25, 12,140**);
 - a second shifting control device (**16,20,120f,120r**) located at a second position on the bicycle, the second shifting control device (**16,20,120f,120r**) including a second rotating member (**26,22,161,162,191,211,212**) for causing the second shifting control device (**16,20,120f, 120r**) to operate a second transmission element (**27,15, 121a,121b**); and
 - interlocking means (**72,63,66,145a,147a**) for interlocking the first shifting control device (**9,10,110f,110r**) and the second shifting control device (**16,20,120f,120r**) so that movement of either the first rotating member (**24,11, 133,134**) or the second rotating member (**26,22,161, 162,191,211,212**) causes the first shifting control device (**9,10,110f,110r**) to operate the first transmission element (**25,12,140**).

2. The apparatus according to claim **1** wherein the interlocking means comprises a coupler (**63,66**) for coupling the first transmission element (**25,12**) and the second transmission element (**27,15**) together.

3. The apparatus according to claim **2** wherein the coupler (**66**) comprises a joint for coupling the first transmission element (**25,12**) and the second transmission element (**27, 15**) together and to a third transmission element (**67**) so that the third transmission element (**67**) may be coupled to the bicycle transmission.

4. The apparatus according to claim **3** further comprising a guide (**69**) in which the joint is slidingly disposed.

5. The apparatus according to claim **2** wherein the first shifting control device (**9,10**) comprises:
 - a first winding drum (**44**) coupled to the first rotating member (**24,11**) for winding and unwinding a cable (**59,14,140a**) of the first transmission element (**25,12**).

6. The apparatus according to claim **5** wherein the second shifting control device (**16,20**) comprises:
 - a second winding drum (**44**) coupled to the second rotating member (**26,22**) for winding and unwinding a cable (**60,13**) of the second transmission element (**27, 15**).

7. The apparatus according to claim **5** wherein the first shifting control device (**9,10**) further comprises:
 - a first positioning unit (**38,39,41**) coupled to the first rotating member (**24,11**) for positioning the first rotating member (**24,11**) at discrete locations.

8. The apparatus according to claim 7 wherein the second shifting control device (16,20) comprises:

a second winding drum (44) coupled to the second rotating member (26,22) for winding and unwinding a cable (60,13) of the second transmission element (27, 15); and

a second positioning unit (38,39,41) coupled to the second rotating member (26,22) for positioning the second rotating member (26,22) at discrete locations.

9. The apparatus according to claim 1 wherein the interlocking means (72,145*a*,147*a*) couples the second transmission element (27,15,121*a*,121*b*) to the first shifting control device (9,10,110*f*,110*r*) so that movement of the first rotating member (24,11,133,134) causes movement of the second transmission element (27,15,121*a*,121*b*).

10. The apparatus according to claim 9 wherein the interlocking means (72,145*a*,147*a*) comprises a coupler (72,145*a*,147*a*) for coupling the second transmission element (27,15,121*a*,121*b*) to the first rotating member (24,11, 133,134).

11. The apparatus according to claim 10 wherein the coupler (72) comprises a ball joint.

12. The apparatus according to claim 9 wherein the second rotating member (26,22) has first and second ends, wherein the second rotating member (26,22) is pivotably coupled to the second shifting control device (16,20) between the first end and the second end, wherein the first end has a manual control surface, and wherein the second end is coupled to the second transmission element (27,15).

13. The apparatus according to claim 9 wherein the first shifting control device (9,10) comprises:

a first winding drum (44) coupled to the first rotating member (24,11) for winding and unwinding a cable (59,14,140*a*) of the first transmission element (25,12).

14. The apparatus according to claim 13 wherein the first shifting control device (9,10) further comprises:

a first positioning unit (38,39,41) coupled to the first rotating member (24,11) for positioning the first rotating member (24,11) at discrete locations.

15. The apparatus according to claim 14 wherein the second rotating member (26,22) has first and second ends, wherein the second rotating member (26,22) is pivotably coupled to the second shifting control device (16,20) between the first end and the second end, wherein the first end has a manual control surface, and wherein the second end is connected to the second transmission element (27,15).

16. The apparatus according to claim 1 wherein the first transmission element (25,12,140) comprises a first cable (59,14,140*a*), and wherein the second transmission element (27,15,121*a*,121*b*) comprises a second cable (60,13,123*a*, 123*b*).

17. The apparatus according to claim 1 wherein the first rotating member (24,11,133,134) comprises a first shifting lever (24,11,133,134).

18. The apparatus according to claim 1 wherein the second rotating member (26,22,161,162,191,211,212) comprises a second shifting lever (26,22,161,162,191,211,212).

19. The apparatus according to claim 1 wherein the first rotating member (24,11,133,134) comprises a first shifting lever (24,11,133,134), and wherein the second rotating member (26,22,161,162,191,211,212) comprises a second shifting lever (26,22,161,162,191,211,212).

20. The apparatus according to claim 1 wherein the first shifting control device (110*f*,110*r*) includes a third rotating member (133,134) for causing the first shifting control device (110*f*,110*r*) to operate the first transmission element (140).

21. The apparatus according to claim 20 wherein the first shifting control device (110*f*,110*r*) is adapted to pull a cable (140*a*) of the first transmission element (140) in response to movement of the first rotating member (133), and wherein the first shifting control device (110*f*,110*r*) is adapted to release the cable (140*a*) of the first transmission element (140) in response to movement of the third rotating member (134).

22. The apparatus according to claim 21 further comprising a third transmission element (121*a*,121*b*), wherein the interlocking means (145*a*,147*a*)couples the second transmission element (121*a*,121*b*) and the third transmission element (121*a*,121*b*) to the first shifting control device (110*f*,110*r*) so that rotating the second rotating member (191) in one direction causes the first shifting control device (110*f*,110*r*) to pull the cable (140*a*) of the first transmission element (140), and rotating the second rotating member (191) in an opposite direction causes the first shifting control device (110*f*,110*r*) to release the cable (140*a*) of the first transmission element (140).

23. The apparatus according to claim 22 wherein the interlocking means (145*a*,147*a*) couples the second transmission element (121*a*,121*b*) and the third transmission element (121*a*,121*b*) to the first shifting control device (110*f*,110*r*) so that rotating the second rotating member (191) in one direction rotates only the first rotating member (133,134), and rotating the second rotating member (191) in an opposite direction rotates only the third rotating member (133,134).

24. The apparatus according to claim 23 further comprising a biasing mechanism (193*a*,193*b*) for biasing the second rotating member (191) to an initial position.

25. The apparatus according to claim 23 wherein the second transmission element (121*a*,121*b*) comprises a first cable (123*a*,123*b*), and wherein the third transmission element (121*a*,121*b*) comprises a second cable (123*a*,123*b*).

26. The apparatus according to claim 23 wherein the first and third rotating members (133,134) each comprises a lever.

27. The apparatus according to claim 23 wherein the second rotating member (191) comprises a lever.

28. The apparatus according to claim 23 wherein the first rotating member (133), the second rotating member (191) and the third rotating member (134) each comprises a lever.

29. The apparatus according to claim 21 wherein the second shifting control device (110*f*,110*r*) includes a fourth rotating member (161,162,211,212) for causing the second shifting control device (120*f*,120*r*) to operate a third transmission element (121*a*,121*b*), and wherein the interlocking means (145*a*,147*a*) interlocks the first shifting control device (110*f*,110*r*) and the second shifting control device (120*f*,120*r*) so that movement of either the first rotating member (133,134), the second rotating member (161,162, 211,212), the third rotating member (133,134), or the fourth rotating member (161,162,211,212) causes the first shifting control device (110*f*,110*r*) to operate the first transmission element (140).

30. The apparatus according to claim 29 wherein the interlocking means (145*a*) connects the second transmission element (121*a*) to the first shifting control device (110*f*,110*r*) so that movement of the second rotating member (161,211) causes the first shifting control device (110*f*,110*r*) to pull a cable (140*a*) of the first transmission element (140), and wherein the interlocking means (147*a*) connects the third transmission element (121*b*) to the first shifting control device (110*f*,110*r*) so that movement of the fourth rotating member (162,212) causes the first shifting control device (110*f*,110*r*) to release a cable (140*a*) of the first transmission element (140).

31. The apparatus according to claim 30 wherein the interlocking means (145a,147a) comprises:

a first coupler (145a) for coupling the second transmission element (121a) to the first rotating member (133); and

a second connector (147a) for connecting the third transmission element (121b) to the third rotating member (134).

32. The apparatus according to claim 31 further comprising a biasing mechanism (163,163a,163b) for biasing the second and fourth rotating members (161,162) to an initial position.

33. The apparatus according to claim 31 wherein the second transmission element (121a) comprises a first cable (123a), and wherein the third transmission element (121b) comprises a second cable (123b).

34. The apparatus according to claim 31 wherein the first and third rotating members (133,134) each comprises a lever.

35. The apparatus according to claim 31 wherein the second and fourth rotating members (161,162,211,212) each comprises a lever.

36. The apparatus according to claim 31 wherein the first rotating member (133), the second rotating member (161, 211), the third rotating member (134) and the fourth rotating member (162,212) each comprises a lever.

37. A bicycle shift control apparatus for a bicycle transmission, the apparatus comprising:

a shifting control device (9,10,110f,110r) adapted to be connected to a transmission control element (25,12, 140) used to control the bicycle transmission, the shifting control device (9,10,110f,110r) including a first shifting lever (24,11,133,134) for causing the shifting control device (9,10,110f,110r) to operate the transmission control element (25,12,140); and

a first coupler (72,145a,147a) for coupling the shifting controls device (9,10,110f,110r) to a first transmission element (13,60,121a,121b) different from the transmission control element (25,12,140).

38. The apparatus according to claim 37 wherein the first coupler (72,145a,147a) is disposed on the first shifting lever (24,11,133,134).

39. A bicycle shift control apparatus for a bicycle transmission, the apparatus comprising:

a shifting control device (110f,110r) adapted to be connected to a transmission control element (140) used to control the bicycle transmission, the shifting control device (110f,110r) including a first rotating member (133,134) for causing the shifting control device (110f, 110r) to operate the transmission control element (140);

a biasing mechanism (152,153) for biasing the first rotating member (133,134) to an initial position; and

a first coupler (145a,147a) for coupling the shifting control device (110f,110r) to a first transmission element (121a,121b) different from the transmission control element (140).

40. The apparatus according to claim 39 wherein the first coupler (145a,147a) is disposed on the first rotating member (133,134).

41. The apparatus according to claim 39 wherein the first rotating member (133,134) comprises a first shifting lever (133,134).

42. A bicycle shift control apparatus for a bicycle transmission, the apparatus comprising:

a shifting control device (110f,110r) adapted to be connected to a transmission control element (140) used to control the bicycle transmission, the shifting control device (110f,110r) including:

a first rotating member (133) for causing the shifting control device (110f,110r) to operate the transmission control element (140) in one direction;

a second rotating member (134) for causing the shifting control device (110f,110r) to operate the transmission control element (140) in an opposite direction; and

a first coupler (145a,147a) for coupling the shifting control device (110f,110r) to a first transmission element (121a,121b) different from the transmission control element (140).

43. The apparatus according to claim 42 further comprising a biasing mechanism (152,153) for biasing the first rotating member (133) and the second rotating member (134) to respective initial positions.

44. The apparatus according to claim 42 wherein the transmission control element (140) comprises a cable (140a), and further comprising a winder (131), wherein the winder (131) pulls the cable (140a) in response to rotation of the first rotating member (133), and wherein the winder (131) releases the cable (140a) in response to rotation of the second rotating member (134).

45. The apparatus according to claim 42 wherein the first rotating member (133) rotates in a first direction for causing the shifting control device (110f,110r) to operate the transmission control element (140) in the one direction, and wherein the second rotating member (134) rotates in an opposite second direction for causing the shifting control device (110f,110r) to operate the transmission control element (140) in the opposite direction.

46. The apparatus according to claim 42 further comprising a second coupler (145a,147a) for coupling the shifting control device (110f,110r) to a second transmission element (121a,121b) different from the transmission control element (140).

47. The apparatus according to claim 46 wherein the first rotating member (133) comprises a first shifting lever (133), and wherein the second rotating member (134) comprises a second shifting lever (134).

48. The apparatus according to claim 47 wherein the first coupler (145a) is adapted to couple the first transmission element (121a) to the first shifting lever (133), and wherein the second coupler (147a) is adapted to couple the second transmission element (121b) to the second lever (134).

49. The apparatus according to claim 46 wherein the first rotating member (133) and the second rotating member (134) are rotatably supported on a main bracket (130), wherein the first coupler (145a) is adapted to couple an inner cable (123a) of the first transmission element (121a) to the first rotating member (133), wherein the second coupler (147a) is adapted to couple an inner cable (123b) of the second transmission element (121b) to the second rotating member (134), and wherein the main bracket (130) includes:

a first stopper (130a) for stopping an outer casing (125a) of the first transmission element (121a); and

a second stopper (130b) for stopping an outer casing of the second transmission element (121b).

50. An auxiliary shift lever apparatus for a bicycle having a main shifting control device (9,10,110f,110r) for operating a transmission control element (25,12,140) connected to a bicycle transmission, wherein the shifting control device (9,10,110f,110r) includes (a) a first main rotating member (24',11',133,134) for causing the main shifting control device (9,10,110f,110r) to operate the transmission control element (25,12,140), and (b) a first transmission element (27,15,121a,121b), the auxiliary shifting apparatus comprising:

a first auxiliary rotating member (26',22',161,162,191, 211,212);

a mounting member (165,195,210) adapted to rotatably mount the first auxiliary rotating member (26',22',161, 162,191,211,212) to a handlebar (5',6',114); and

a first coupler (72,171,172,192*a*,192*b*,210*a*,210*b*) for coupling the first auxiliary rotating member (26',22', 161,162,191,211,212) to the first transmission element (27,15,121*a*,121*b*).

51. The apparatus according to claim 50 wherein the first auxiliary rotating member (26',22',161,162,191,211,212) comprises a first auxiliary shift lever (26',22',161,162,191, 211,212).

52. The apparatus according to claim 50 further comprising a biasing mechanism (163,163*a*,163*b*,193*a*) for biasing the first auxiliary shifting lever (161,162,191,211,212) to an initial position.

53. The apparatus according to claim 50 wherein the main shifting control device (110*f*,110*r*) includes (c) a second main rotating member (133,134) for causing the shifting control device (110*f*,110*r*) to operate the transmission control element (140), and (d) a second transmission element (121*a*,121*b*), and wherein the auxiliary shift lever apparatus further comprises:

a second auxiliary rotating member (161,162,211,212) rotatably mounted to the base member (165,210); and

a second coupler (171,172,210*a*,210*b*) for coupling the second auxiliary rotating member (161,162,211,212) to the second transmission element (121*a*,121*b*).

54. The apparatus according to claim 53 further comprising:

a first biasing mechanism (163,163*a*) for biasing the first auxiliary rotating member (161) to an initial position; and

a second biasing mechanism (163,163*b*) for biasing the second auxiliary rotating member (162) to an initial position.

55. The apparatus according to claim 53 wherein the first and second auxiliary rotating members (161,162) rotate in a same direction to operate the first and second transmission elements (121*a*,121*b*).

56. The apparatus according to claim 53 wherein the first and second auxiliary rotating members (161,162) rotate in opposite directions to operate the first and second transmission elements (121*a*,121*b*).

57. The apparatus according to claim 50 wherein the main shifting control device (110*f*,110*r*) includes (c) a second

main rotating member (133,134) for causing the shifting control device (110*f*,110*r*) to operate the transmission control element (140), and (d) a second transmission element (121*a*,121*b*) coupled to move the second main rotating member (133,134), and wherein the auxiliary shift lever apparatus further comprises a second coupler (192*a*,192*b*) for coupling the first auxiliary rotating member (191) to the second transmission element (121*a*,121*b*).

58. The apparatus according to claim 57 wherein the first auxiliary rotating member (191) comprises a lever.

59. The apparatus according to claim 58 wherein the first coupler (192*a*) is disposed on the first auxiliary rotating member (191).

60. The apparatus according to claim 59 further comprising a second auxiliary rotating member (192), and wherein the second coupler (192*b*) is disposed on the second auxiliary rotating member (192).

61. The apparatus according to claim 60 wherein the first auxiliary rotating member (191) causes rotation of the second auxiliary rotating member (192) when the first auxiliary rotating member (191) rotates in a selected direction.

62. The apparatus according to claim 61 further comprising a biasing mechanism (193*a*,193*b*) for biasing the first auxiliary rotating member (191) to an initial position.

63. The apparatus according to claim 58 further comprising:

a second auxiliary rotating member (192*a*), wherein the first coupler is disposed on the second auxiliary rotating member (192*a*);

a third auxiliary rotating member (192*b*), wherein the second coupler is disposed on the third auxiliary rotating member (192*b*).

64. The apparatus according to claim 63 wherein the first auxiliary rotating member (191) causes rotation of the second auxiliary rotating member (192*a*) when the first auxiliary rotating member (191) rotates in a first direction, and wherein the first auxiliary rotating member (191) causes rotation of the third auxiliary rotating member (192*b*) when the first auxiliary rotating member (191) rotates in an opposite second direction.

65. The apparatus according to claim 64 further comprising a biasing mechanism (193*a*,193*b*) for biasing the first auxiliary rotating member (191) to an initial position.

* * * * *

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United States Patent [19]

Kageyama

[11] **Patent Number: 5,862,709**

[45] **Date of Patent: Jan. 26, 1999**

[54] **BICYCLE SHIFT CONTROL DEVICE**

[75] Inventor: **Tomohiko Kageyama**, Sakai, Japan

[73] Assignee: **Shimano, Inc**, Osaka, Japan

[21] Appl. No.: **905,033**

[22] Filed: **Aug. 1, 1997**

Related U.S. Application Data

[63] Continuation of Ser. No. 560,737, Nov. 20, 1995, abandoned.

[30] **Foreign Application Priority Data**

Aug. 9, 1995 [JP] Japan 7-203022

[51] **Int. Cl.**^{6} **B62M 25/04**

[52] **U.S. Cl.** **74/489**; 74/501.6; 74/502.2

[58] **Field of Search** 74/489, 501.6, 74/502.2, 506

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Primary Examiner—Richard M. Lorence
Attorney, Agent, or Firm—James A. Deland

[57] **ABSTRACT**

A bicycle shift control device comprises a guide member for mounting relative to an axis of a structural member of a bicycle. A rotatable shift member is guided by the guide member for rotation about an axis, wherein the axis of rotation of the rotatable shift member is inclined relative to the axis of the guide member.

21 Claims, 10 Drawing Sheets

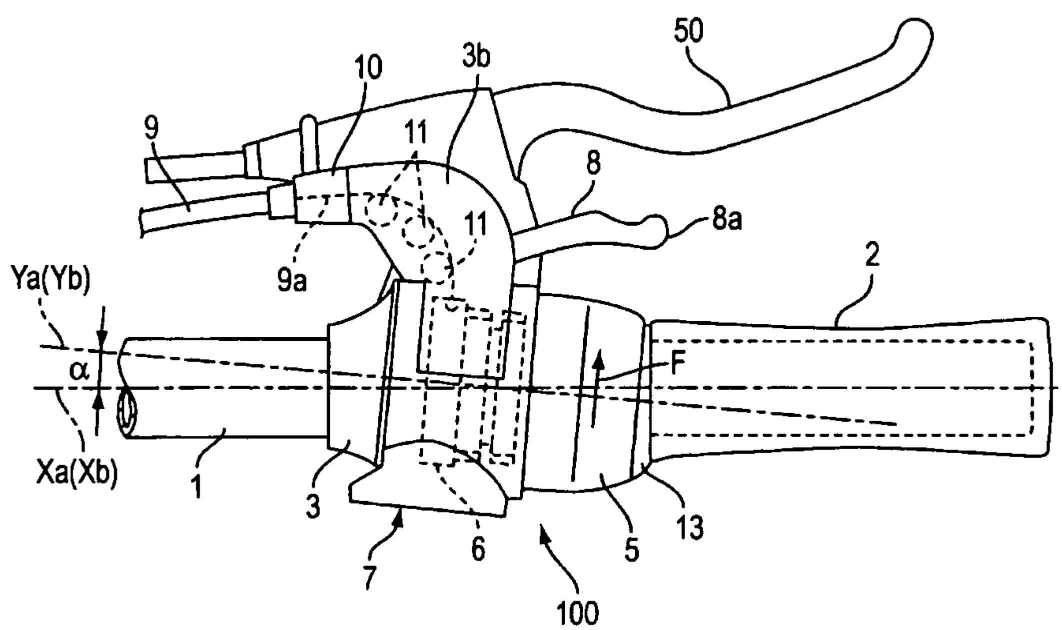


FIG. 1

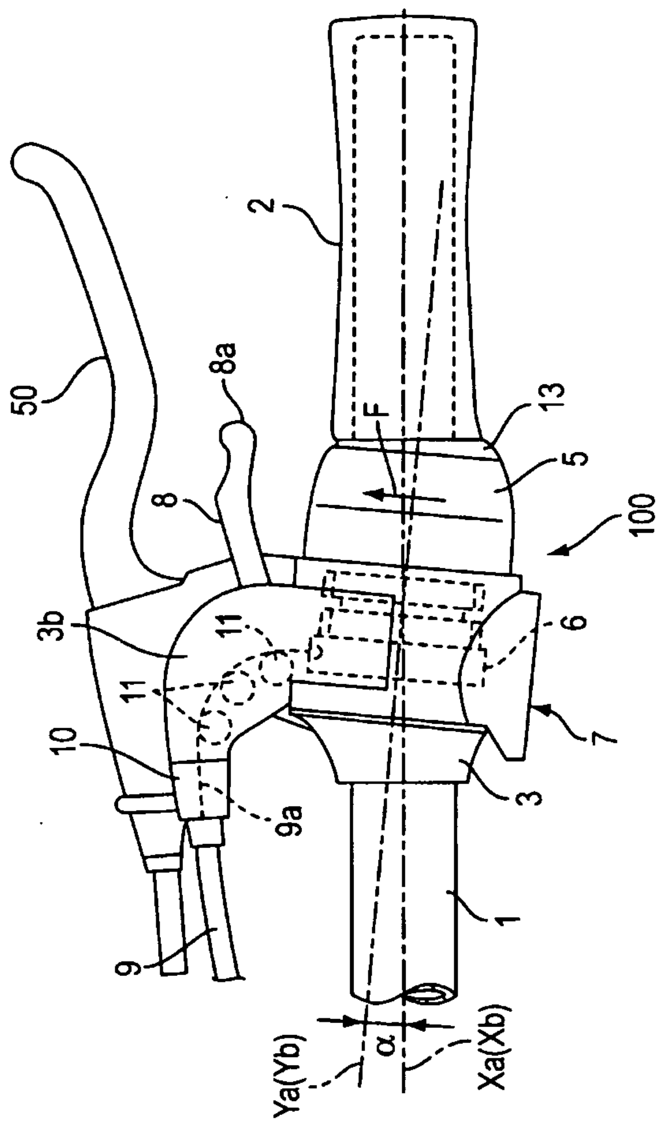


FIG. 2

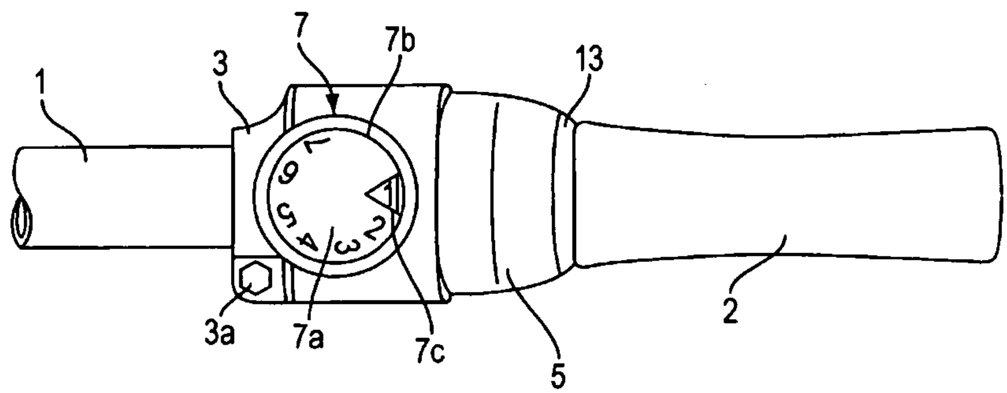
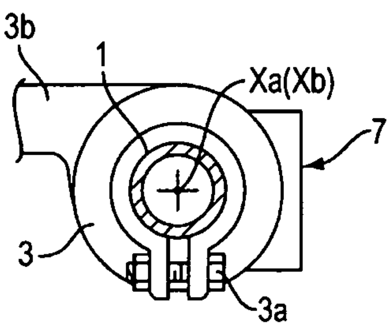
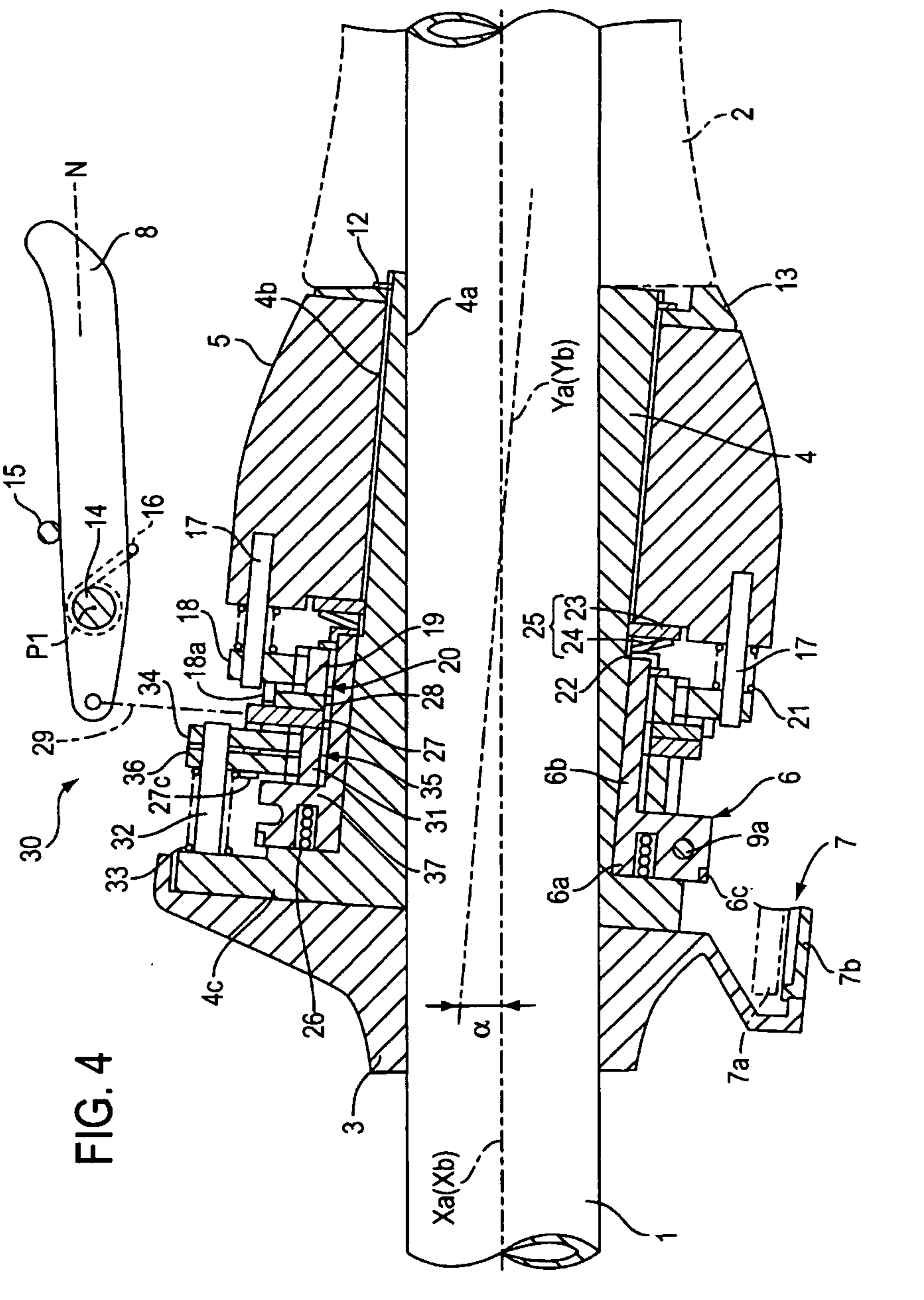


FIG. 3

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24
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27
27c
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P1
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Ya(Yb)
α

FIG. 4

FIG. 5

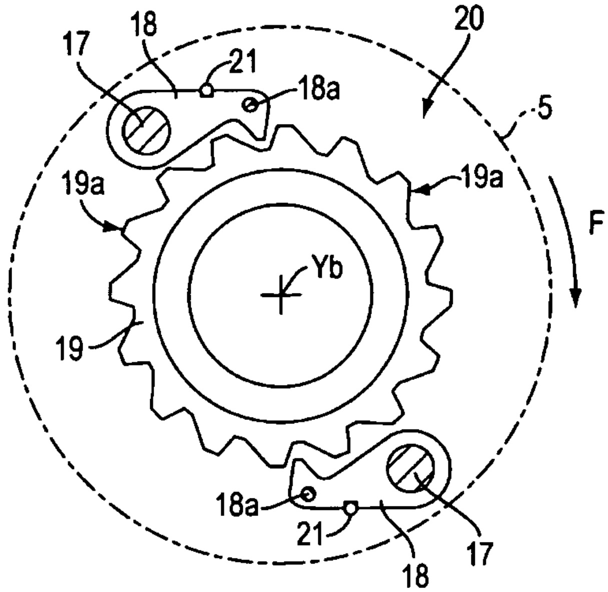


FIG. 6(A)

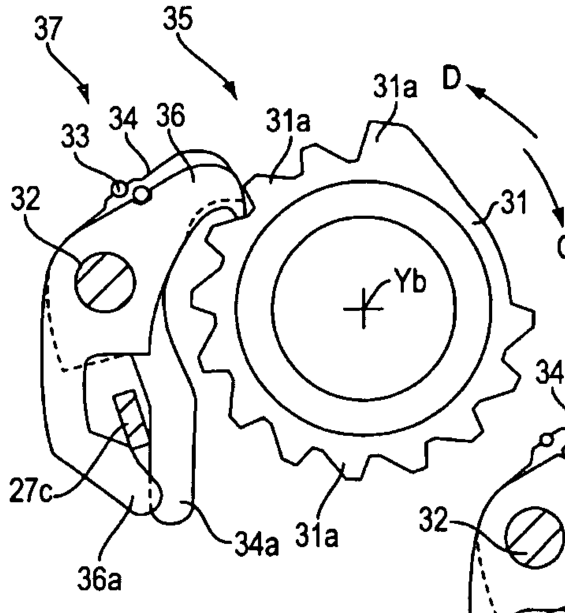


FIG. 6(B)

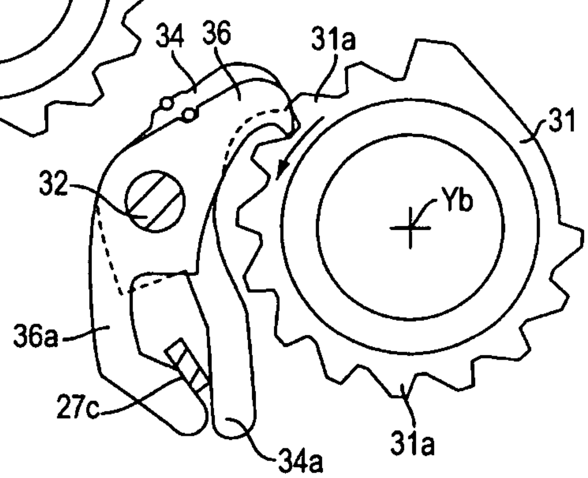
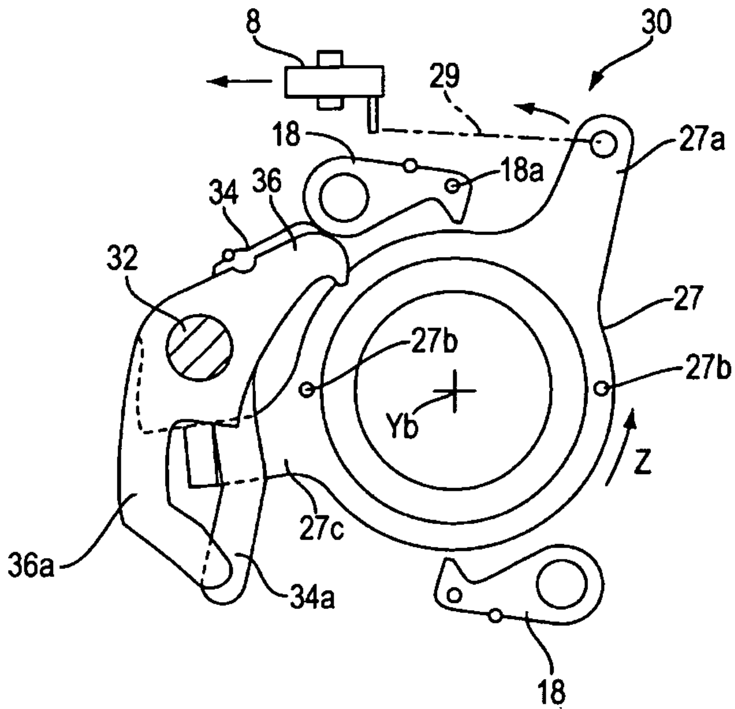


FIG. 7


8
30
29
27a
18
18a
34
36
32
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Yb
Z
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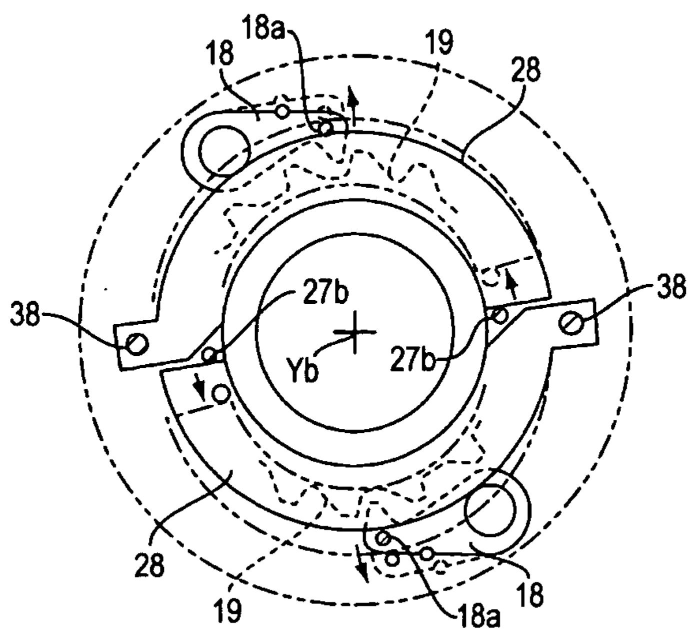
34a
18

FIG. 8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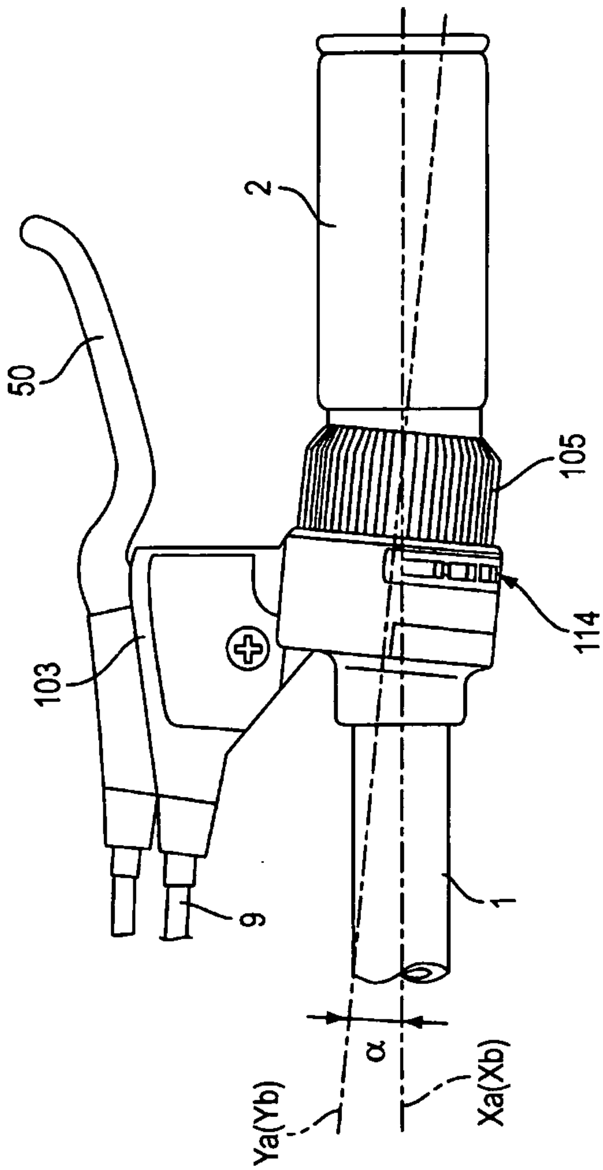
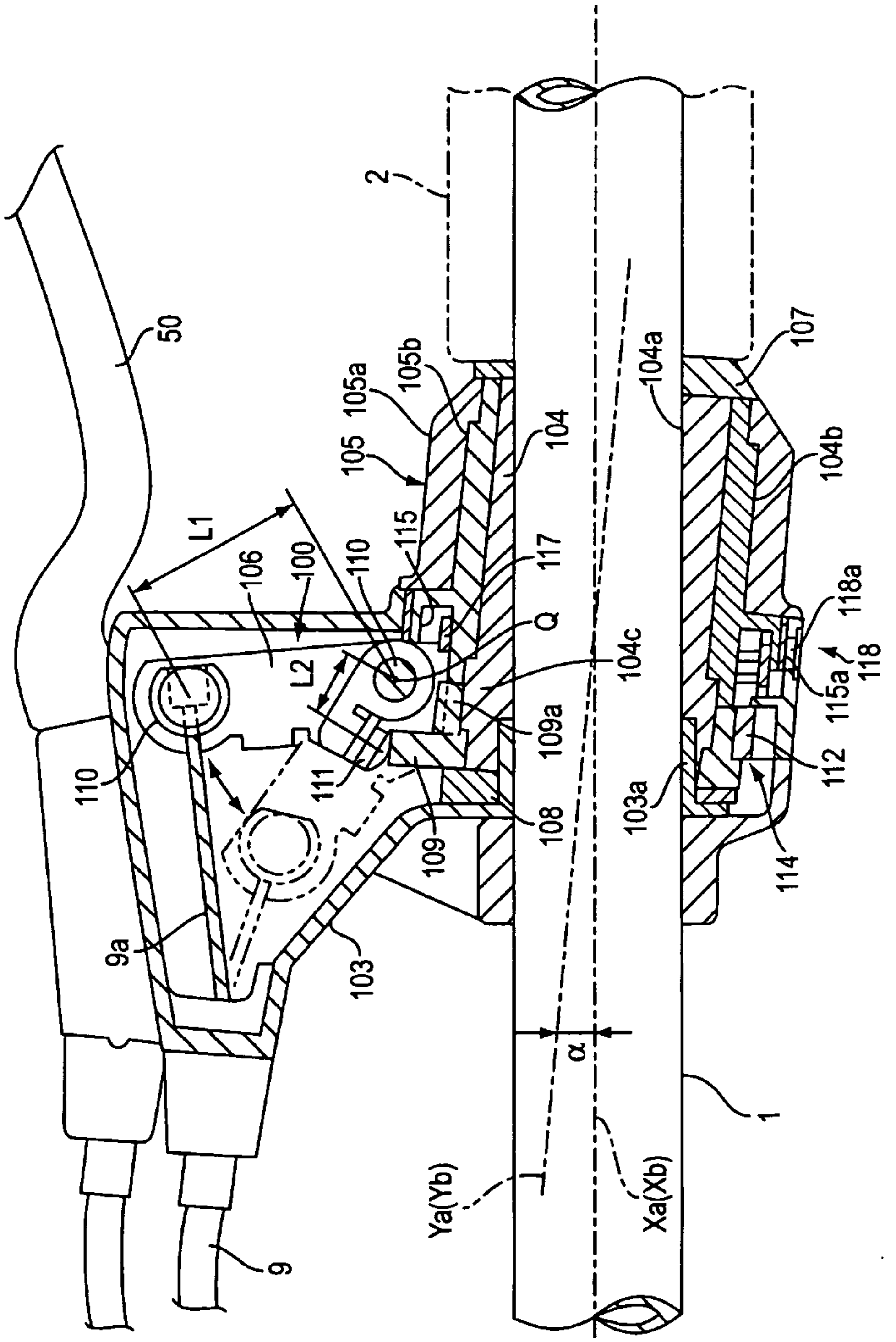
19
18a

FIG. 9

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104b
L1
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100
110
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Q
104c
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118
115a
L2
109a
112
111
110
108
103a
109
114
9a
103
α
1
Ya(Yb)
Xa(Xb)
9

FIG. 10

FIG. 11

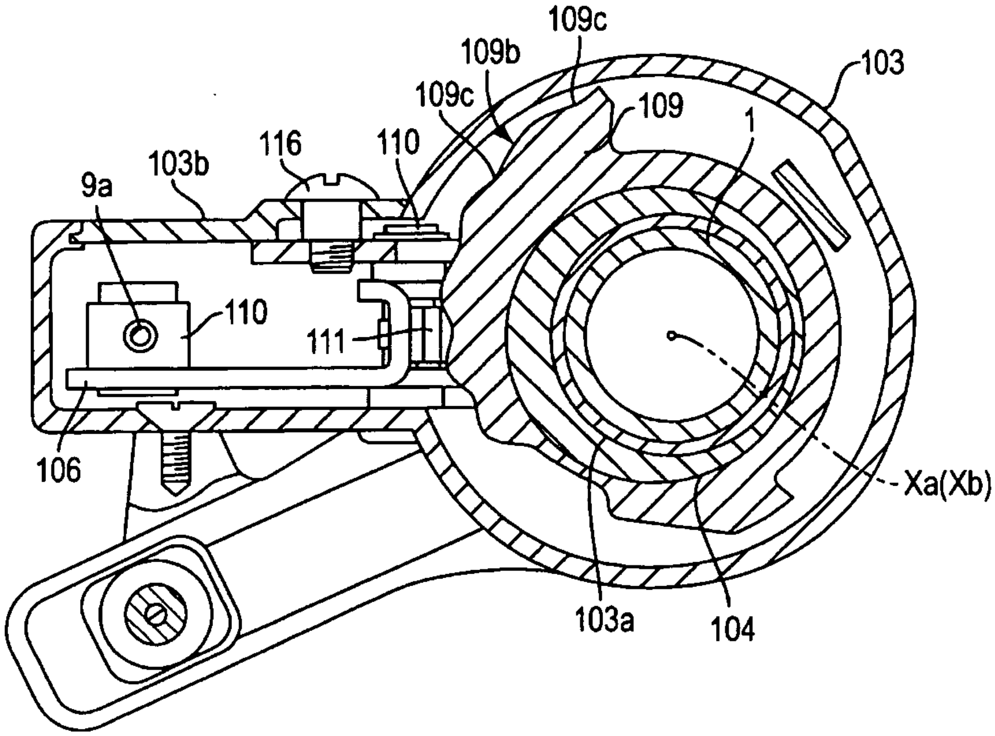

109c
109b
103
109c
109
116
110
1
103b
9a
110
111
106
Xa(Xb)
103a
104

FIG. 12

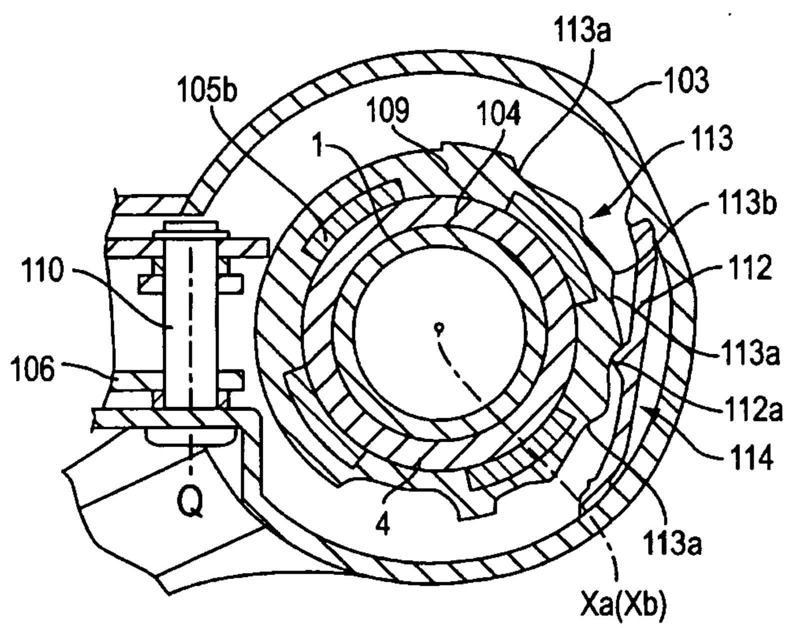

113a
103
105b
109
104
113
1
113b
110
112
113a
106
112a
114
Q
4
113a
Xa(Xb)

FIG. 13

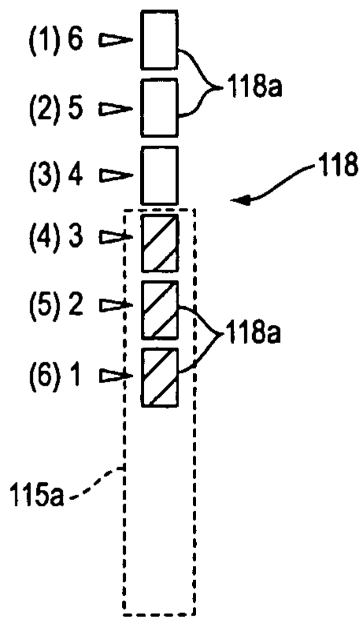

(1) 6
(2) 5
(3) 4
(4) 3
(5) 2
(6) 1
118a
118
118a
115a

FIG. 14

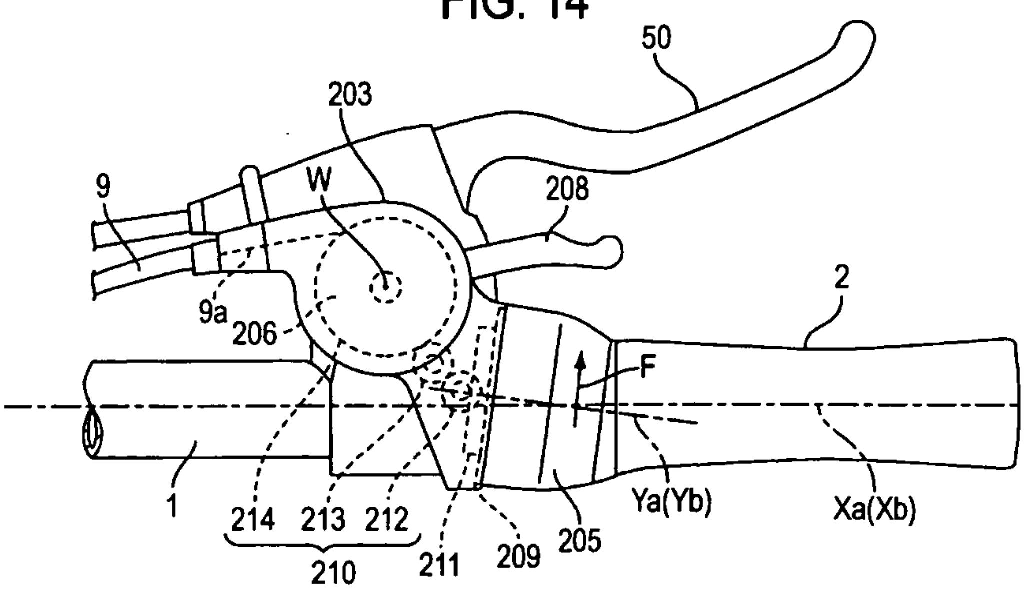

50
203
9
W
208
2
9a
206
F
1
214
213
212
210
211
209
205
Ya(Yb)
Xa(Xb)

FIG. 15

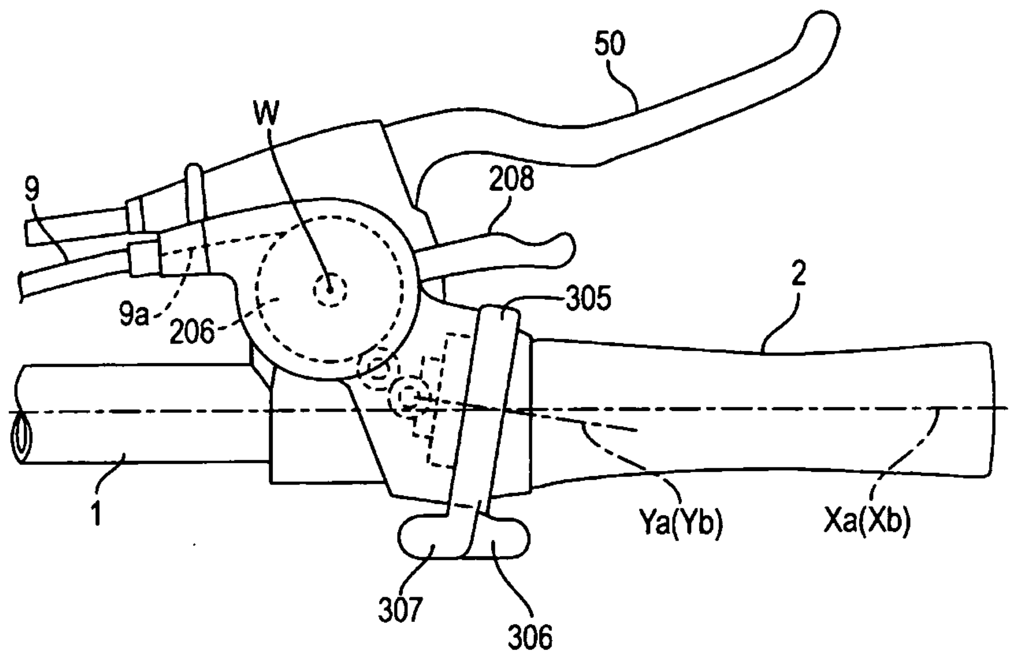


FIG. 16

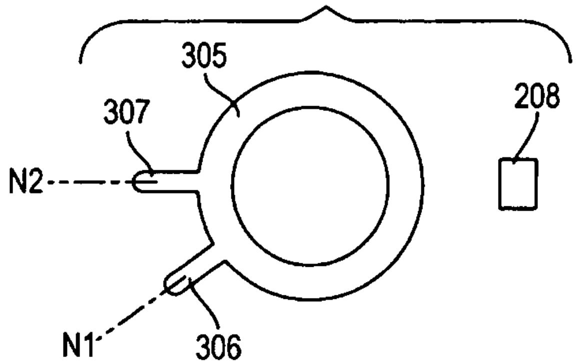
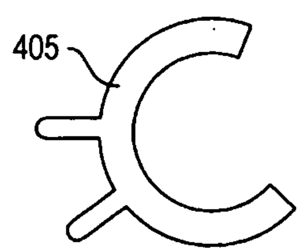


FIG. 17



BICYCLE SHIFT CONTROL DEVICE

This is a Continuation of application Ser. No. 08/560,737, filed Nov. 20, 1995, now abandoned.

BACKGROUND OF THE INVENTION

The present invention is directed to bicycle shift control devices and, more particularly, to shift control devices capable of mounting about the bicycle handlebar for rotation about the axis of the handlebar.

A conventional bicycle shift control device of the type which mounts on the handlebar of the bicycle for rotation about the axis of the handlebar has been disclosed, for example, in International Patent Publication W093/09993. In this publication, a shift member of sleeve form is fit over the peripheral surface of the handlebar adjacent to a grip that has been installed on the peripheral surface of the handlebar. The shift member is rotatable around the axis of the handlebar. With this device, the thumb of a hand gripping the grip is placed into contact with the peripheral surface of the shift member while rotating the shift member so that a shift cable winding reel takes up the shift cable or returns it so that operating displacement is provided to the derailleur that is connected to the other end of the shift cable.

The grip that is gripped by the palm of the hand and the fingers takes the form of cylindrical member installed concentrically with the handlebar axis, and the cylindrical shift member that is operated by the thumb is also a cylindrical member installed concentrically with the handlebar axis. Thus, the operating displacement of the shift member takes the form of rotational displacement around the axis of the handlebar. However, the sliding motion of the thumb of the hand is a swiveling motion having as its center the joint located at the origin of the thumb, so there is discrepancy between the direction of shift member rotational displacement and the direction of thumb swivel. As a result, it is necessary to shift the hand from the grip in order to rotate the control member by swiveling the thumb, sometimes producing a degree of comfort of operation that is not satisfactory. The discomfort during operation is particularly noticeable when the shift member is rotated to a significant degree in order to produce a large change in shift position.

SUMMARY OF THE INVENTION

The present invention is directed to a shift control member of the type which mounts about a bicycle handlebar for rotation about the axis of the handlebar wherein the direction of displacement of the shift control member closely matches the natural movement of the thumb. In one embodiment of the present invention, a bicycle shift control device comprises a guide member for mounting relative to an axis of a structural member of a bicycle. A rotatable shift member is guided by the guide member for rotation about an axis, wherein the axis of rotation of the rotatable shift member is inclined relative to the axis of the guide member. If desired, the axis of inclination may be between approximately 5° and 40°. In some embodiments, the rotatable shift member may be a ring or partial ring which moves over a sliding path formed by the guide member, and one or more projections may extend from the ring to facilitate operation by the thumb.

Various transmission mechanisms may be used to convert rotation of the shift member into a pulling force for a shift cable. For example, a transmission mechanism may comprise a shift lever, a winding member for attachment to a shift cable, a clutch for coupling rotation of the rotatable shift member to the winding member in a first rotational direction, and an interlink mechanism coupled to the shift lever and to the winding member for allowing the winding member to move in a second rotational direction in response to movement of the shift lever. Alternatively, a transmission mechanism may comprise a slide lever pivotally coupled to the shifting device at one end and to the shift cable at another end, a cam coupled for rotation in response to rotation of the rotatable shift member, and a cam follower coupled to the slide lever.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plane view illustrating a particular embodiment of a bicycle shift control device according to the present invention;

FIG. 2 is a view illustrating a particular embodiment of a speed indicator according to the present invention;

FIG. 3 is a cross-sectional view of the bicycle shift control device according to the present invention showing a particular embodiment of a mounting bracket;

FIG. 4 is a cross-sectional view of the bicycle shift control device shown in FIG. 1;

FIG. 5 is a side view illustrating a particular embodiment of a one-way clutch mechanism employed in the bicycle shift control device shown in FIG. 1;

FIG. 6 is a side view illustrating a particular embodiment of a position and full return stop mechanism employed in the bicycle shift control device shown in FIG. 1;

FIG. 7 is a side view illustrating a particular embodiment of a transmission mechanism employed in the bicycle shift control device shown in FIG. 1;

FIG. 8 is a side view illustrating a particular embodiment of a clutch mechanism employed in the bicycle shift control device shown in FIG. 1;

FIG. 9 is a plan view illustrating another embodiment of a bicycle shift control device according to the present invention;

FIG. 10 is a cross-sectional view of the bicycle shift control device shown in FIG. 9;

FIG. 11 is a side view illustrating a particular embodiment of a shift operating cam mechanism employed in the bicycle shift control device shown in FIG. 10;

FIG. 12 is a side view illustrating a particular embodiment of an indexing mechanism employed in the bicycle shift control device shown in FIG. 10;

FIG. 13 is a view illustrating a particular embodiment of a speed indicating mechanism employed in the bicycle shift control device shown in FIG. 10;

FIG. 14 is a plane view illustrating another embodiment of a bicycle shift control device according to the present invention;

FIG. 15 is a plane view illustrating another embodiment of a bicycle shift control device according to the present invention;

FIG. 16 is a side view of a particular embodiment of a rotatable shift member used in the bicycle shift control device shown in FIG. 15; and

FIG. 17 is a side view of an alternative embodiment of a rotatable shift member used in the bicycle shift control device shown in FIG. 16.

DETAILED DESCRIPTION OF THE EMBODIMENTS

As depicted in FIGS. 1, 2, 3, and 4, a shift control device 100 is located adjacent to a grip 2 mounted with reference

to a specified width on the peripheral surface at the end section of a bicycle handlebar 1 of pipe form which is one structural member of the bicycle. This shift control device 100 is provided with a mounting bracket 3 which is mounted on the peripheral surface of the bicycle handlebar 1. The inside perimeter surface of the mounting bracket 3 serves as a mounting surface that conforms in shape to the peripheral surface of the handlebar 1. When mounted on the handlebar, the center axis of the inside perimeter surface, i.e., mounting axis Xa, is substantially aligned with the axis Xb of the handlebar 1. In order to fix the mounting bracket 3 to the handlebar 1, a clamp bolt 3*a* is provided for clamping a mounting surface having a slit structure to the peripheral surface of the handlebar 1. The mounting bracket 3 forms an integrated structure with the brake lever 50.

The mounting bracket 3 is assembled with a cylindrical guide member 4 provided with a through hole 4*a* through which the handlebar passes. The rotating shift member 5 and a winding member 6 fit slidably over a peripheral surface having a round cross section which is formed as a guide section on the outside of the guide member 4. Since the guide surface is the surface of a cylindrical member, the sliding displacement of the rotating shift member 5 takes place stably and with a high degree of accuracy.

As shown in FIG. 4, angle α, which represents the incline of the axis Ya of the peripheral surface 4*b* of the guide member 4 (i.e., the axis of rotation Yb of the rotating shift member 5) with respect to the axis of the through hole 4*a* (i.e., the handlebar axis Xb or the mounting axis Xa) about a vertical axis extending perpendicular to the plane of the drawing, is 5^0 in this practical example. A speed indicator 7 which has numbered speed marks is provided to the outside of the mounting bracket 3. At the opposite side, a shift lever 8 is attached and a cable insertion case section 3*b* is provided. The outer casing of the shift cable 9 from the front derailleur, rear derailleur, or other bicycle shift device (not shown) is supported by an outer casing holder 10 provided to the cable insertion case section 3*b*, and the inner cable 9*a* of the shift cable 9 is guided from the aforementioned outer casing holder 10 into the mounting bracket 3 by a plurality of guide rollers 11 located in the interior of the cable insertion case section 3*b*. The inner cable 9*a* is thereafter linked with the winder member 6 and is rotated in the take up direction or the return direction of the winder 6 by the rotating shift member 5 and the shift lever 8, so that the inner cable 9*a* is pulled or slackened. The shift position to which the shift device has been shifted can be readily determined from the indicator 7.

As shown in FIG. 4, in this example the winder member 4 and the rotating shift member 5 take the form of complete cylinders, are slid over the peripheral surface 4*b* of the aforementioned guide member 4, and are prevented from coming off on the grip 2 side by a stopper ring 12. A side guide plate 13 is inserted between the stopper ring and the right edge of the rotating shift member 5; this side guide plate 13 is provided with a 5^0 inclined surface, taking into consideration the fact that the axis of rotation Yb of the rotating shift member 5 is inclined at an angle of 5^0 with respect to the axis of the through hole 4*a* of the guide member 4.

As shown in FIG. 3, the shift lever 8 is rotatably mounted on the spindle 14 of the mounting bracket 3, and it is slidably biased by a return spring 16 so that it automatically returns to its home position N in contact with a lever restraining member 15 provided to the mounting bracket 3. The aforementioned spindle 14 is positioned on the front side of the handlebar 1 with respect to the direction of bicycle forward progress when the mounting bracket 3 is attached to the handlebar 1, and axis P1 is a vertical axis lying in the vertical direction of the bicycle frame. Specifically, the shift lever 8 is positioned such that its operating section 8*a* is located on the front side of the handlebar 1 when the mounting bracket 3 is attached to the handlebar 1 as shown in FIG. 1. Shift lever 8 comprises a sliding lever that slides around the aforementioned axis P1 and is operated by the index finger of the hand that grips the grip 2 of the handlebar 1. In contrast, the incline of the axis of rotation Yb of the rotating shift member 5 with respect to the aforementioned mounting axis Xa, i.e., the handlebar axis Xb, is set so as to diverge to a greater degree from the aforementioned mounting axis Xa closer to the central longitudinal axis of the bicycle, and is operated by the thumb of the hand that grips the grip 2 of the handlebar 1.

In this practical example, the winder member 6 is rotated in one direction by the sliding displacement of the rotating shift member 5, and the winder member 6 is rotated in the other direction by the sliding displacement of the shift lever 8. The following description refers to FIGS. 4 through 8.

A clutch 20 for transmitting the rotational force of the rotating shift member 5 to the winder member 6 comprises a pair of clutch pawls 18 and 18 that are slidably attached to the rotating shift member 5 through pawl shafts 17 and a clutch gear 19 that is attached so as to rotate in integrated fashion at one end of the winder 6 through spline engagement. The clutch pawls 18 and 18 are biased by pawl springs 21 so as to engage one of the plurality of toothed sections 19*a* of the clutch gear 19, and thus the clutch 20 is biased in the engaged position.

At the peripheral surface 4*b* of the guide 4, a fixing plate 22 is located between the winder member 6 and the rotating shift member 5 and checked by a plate mounting section to prevent it from sliding in the direction of the winder member 6. A friction plate 23 positioned between this fixing plate 22 and the rotating shift member 5, and a brake spring 24 positioned between the friction plate 23 and the fixing plate 22 together constitute a brake 25 on the rotating shift member 5. The friction plate 23 slides in the direction of the axis with respect to the guide member 4 by means of spline engagement with the guide member 4, but it does not slide in the circumferential direction. The brake spring 24 slidably biases the friction plate 23 so that it is pressed against the end of the rotating shift member 5, and by this operation the brake 25 produces a friction braking action on the rotating shift member 5.

The spring chamber formed in the winder drum section 6*a* of the winder member 6 is provided with a return spring 26. One end of this return spring 26 is retained by a ring flange section 4*c* which extends diametrically from the guide member 4, and the other end is retained by the winder member 6. Spring 26 undergoes elastic deformation as the winder member 6 rotates in the take up direction and serves to rotate the winder member in the return direction by the force of elastic recovery produced by this deformation. The guide member flange section 4*c* is connected to the mounting bracket 3 by a thread coupling. The return spring 26, an externally fitted release plate 27 that is capable of relative rotation and that is located between the aforementioned clutch gear 19 and the projecting drum section 6*b* which protrudes in the direction of the axis of the winder member, a pair of clutch disengage members 28 and 28 located between the release plate 27 and the aforementioned clutch gear 19, and an interlink rod 29 that links the aforementioned shift lever 8 and the aforementioned release plate 27 together constitute an interlink mechanism for interlinking the shift lever 8 and the winder member 6.

A ratchet gear 31 attached between the projecting drum section 4*b* of the winder member 6 and the aforementioned release plate 27 such that it experiences integrated rotation through spline engagement, and a position pawl 34 that is slidably attached at the rim section 4*c* of the guide member by a pawl spindle 32 and that is slidably biased by a pawl spring 33 so as to engage one of the tooth sections 31*a* of the ratchet gear 31 constitute a position mechanism 35 for holding the winder member 6 at a specified position of rotation. The aforementioned ratchet gear 31 and a return stop pawl 36 slidably attached to the aforementioned pawl spindle 32 constitute a full return stop mechanism that prevents excessive rotation when the winder member 4 rotates in the return direction.

Since the ratchet 20 is engaged through the action of the pawl spring 21 and the position pawl 34 is engaged by a tooth section 31*a* of the ratchet gear 31 so that the position mechanism 35 does not rotate in the winder member 4 return direction, the rotating shift member 5 can rotate only in the direction indicated by arrow F in FIG. 1. When the rotating shift member 5 is operated by sliding rotation, the clutch 20 transmits the force of rotation of the rotating shift member 5 to the winder member 6, and the winder member 6 rotates in direction C (the direction in which the inner cable 9*a* is taken up). At this time, the ratchet gear 31, which rotates together with the winder member 6, pushes the position pawl 34 and the return stop pawl 36 away from the toothed sections 31*a* as it rotates, due to the cam action produced by the shape of the tooth sections 31*a*. Each time that the winder member 6 rotates one rotational pitch so that the shift device is shifted by one position, the sliding bias provided by the pawl spring 33 causes the position pawl 34 to automatically engage the next tooth section 31*a* adjacent to the tooth section 31*a* that was engaged prior to shifting, so that the position mechanism 35 returns to the operative state. Thus, each time that the winder member 4 rotates one rotational pitch to a new position of rotation, the action of the position mechanism 35 serves to maintain this position of rotation.

When the winder member 6 is caused to undergo take up rotation by the rotating shift member 5, it is capable of sliding in a single operation until the position pawl 34 comes into contact with the last tooth section 31*a* of the ratchet gear 31. This permits shifting so that the shift device is shifted to shift positions only one position away from the shift position prior to the shifting operation while also permitting shifting so that the winder member 6 can rotate, for example, between the lowest speed location and the highest speed location in a single operation so that the shift device can be switched two or more positions from the shift position prior to the shifting operation in a single operation.

On the other hand, when the shift lever 8 is slid from its home position N towards the direction of the handlebar 1, the interlock rod 29 pulls the operating arm component 27*a* of the release plate 27 as indicated in FIG. 7 so that the release plate 27 rotates from the position depicted in FIG. 7 in direction of rotation Z, whereupon a pair of operating pins 27*b* and 27*b* provided to the release plate 27 move from the disengaged position indicated by the solid lines in FIG. 8 to the operating position indicated by the broken lines and are pressed against the free end of the clutch disengage member 28 located on one side and against the free end of the clutch disengage member 28 located on the other side, respectively. Thus, each clutch disengage member 28 pivots around a pivot pin 38, provided to the guide member 4 at a location on the side opposite the side acted upon by the aforementioned operating pin 27*b*, slides away from the winder member 6 from the engaged position indicated by the solid lines in FIG. 8 to the disengaged position indicated by the broken lines, and is pressed against the pin section 18*a* of one of the clutch pawls 18 so that the clutch pawl 18 is disengaged from the clutch gear 19. That is, the clutch 20 is disengaged. A release arm section 27*c* that protrudes from the release plate 27, as depicted in FIG. 7, and whose protruding end is positioned between the arm section 34*a* of the position pawl 34 and the arm section 36*a* of the return stop pawl 36, rotates in the direction of rotation Z of the release plate 27 and moves from the disengaged position depicted in FIG. 7 to the operating position depicted in FIG. 6. The release arm section 27*c* is pressed against the arm section 36*a* of the return stop pawl 36, and it slides the return stop pawl 36 so that the pawl tip is inserted between tooth sections 31*a* and 31*a* of the ratchet gear 31. In this way, the full return prevention mechanism 37 automatically assumes the operational state depicted in FIG. 6. When the winder member 6 subsequently rotates in the return direction, the rotational pitch of the winder member 6 is regulated to one rotational pitch such that the shift device shifts by only one shift position. At this time, the pawl tip of the position pawl 34 is in contact with the tooth section 31*a* of the ratchet gear 31 and performs a stopping action so that the winder member 6 does not rotate.

When the shift lever 8 is slid further towards the handlebar so that the release plate 27 is rotated further in the direction of rotation Z, the release arm section 27*c* of the release plate 27 moves to the operating position depicted in FIG. 6 and is pressed against the arm section 34*a* of the position pawl 34 so that the position pawl 34 is disengaged from the tooth section 31*a* of the ratchet gear 31. Thus, the position mechanism 35 permits the winder 6 to return by means of the operating force of the inner cable 9*a* and the return spring 26. As the shift lever 8 is subsequently slid back by the return spring 16 so that the release arm section 27*a* of the release plate 27 slides back, the position pawl 34 slides towards the ratchet gear 31 due to the action of the pawl spring 33 so that it comes into contact with the next tooth section 31*a* adjacent to the tooth section 31*a* in which it was in contact prior to the shifting operation. Thus, the position mechanism has a position retaining action with respect to the winder member 6 after it has rotated one rotational pitch.

Therefore, the shift lever 8 can only be operated to return the winder member 4. Each time that the shift lever 8 is slid from its home position N, the winder member 6, which is linked with the operation of the shift lever 8 through the interlink mechanism 30, rotates in direction of rotation D (the direction of take up of the inner cable 9*a*) due to the operating force of the inner cable 9*a* and the return spring 26. The winder member 4 is restricted to rotation by one rotational pitch due to the action of the full return stop mechanism 37, so when a position at which the shift device has been shifted by one shift position is reached, this position of rotation is maintained by the position mechanism 35.

The shift indicator 7 is mounted on the mounting bracket 3 so as to rotate around an axis that is substantially perpendicular to the handlebar axis Xb, and it comprises a rotating component 7*a* provided with the aforementioned speed indication marks and a stationary component 7*b* that takes the form of a transparent component that is positioned so as to cover the aforementioned rotating component 7*a* (so that the speed indication marks are visible) and is fixed to the mounting bracket 3. The aforementioned rotating component 7*a* is linked by engagement with a gear section 6*c*

formed on one end of the winder member 6, as shown in FIG. 3, and rotates in tandem with the winder member 6. When the winder member 6 reaches a specified position of rotation, the mark from among the plurality of aforementioned speed indication marks that indicates the shift position of the shift device halts in alignment with an indicator mark 7c provided to the stationary component 7b and depicted in FIG. 2A. By noting which speed indication mark is the speed indication mark that is aligned with the indicator mark 7c, it is possible to determine the speed to which the shift device has been shifted.

FIG. 9 is a plan view illustrating another embodiment of a bicycle shift control device according to the present invention. In this embodiment, operation of the shift cable 9 is conducted solely by a rotating shift member 105, and no shift lever 8 is provided.

As depicted in FIG. 10, the rotating shift member 105 comprises an outer sleeve 105a on whose peripheral surface serrations have been formed to prevent slip and an inside sleeve 105b that fits inside the outer sleeve 105a and that is constituted by pressure bonding, by adhesion, or by linkage so as to undergo integrated rotation with the outer sleeve 105a. If desired, the outer sleeve 105a may be fabricated from an elastic material such as rubber that is comfortable to the finger and has non-slip properties, and the inside sleeve 105b may be fabricated from metal which can be machined with high accuracy. The rotating shift member (105) fits slidably over the exterior of the peripheral surface 104b of the guide member 104 which is fixed to the handlebar 1. The rotating shift member 105 is prevented from coming off the guide member 104 by a stopper section 104c formed at one end of the guide member 104 and a first side guide plate 107 located at the other end. The guide member 104 is provided with a through hole 104a, and the guide member 104 is slid onto the handlebar 1 using this through hole 104a so that the positional relationship of the guide member 104, and therefore the rotating shift member 105, with respect to the handlebar is determined. That is, the axis of rotation Yb of the rotating shift member 105 is inclined at an angle α (5° in this case) with respect to the handlebar axis Xb.

In order to achieve the desired angle of inclination, the axis Ya of the peripheral surface 104b of the guide member 104 that forms the displacement guide path for the rotating shift member is inclined by angle α with respect to the axis Ya of the through hole 104a. The aforementioned guide member 104 is formed so as to slip over the handlebar 4, and in order to fix the guide member 104 to the handlebar 1, the mounting bracket 103 is provided with a mounting cylinder 103a that slips over the handlebar 1. The edge of this mounting cylinder 103a and the edge of the guide member 104 mesh. As depicted in FIG. 11, the mounting bracket 103 forms, by means of a thread coupling, an integrated unit with a lever bracket section for attaching a brake lever 50 to the handlebar 1.

As shown in FIG. 10, the shift control device 100 comprises a shift cam section 109, consisting of a rotary cam member rotatably attached at the peripheral surface 104b of the guide member 104, and a slide lever 106 attached to the mounting bracket 103 through a spindle 110 so that it slides around axis Q. Engagement of a spline formed in the boss section 109a of the shift cam section 109 and a spline formed on one end of the inside sleeve 105b of the aforementioned rotating shift member 105 serves to link the shift cam section 109 and the rotating shift member 105 so that they rotate in integrated fashion. Movement in the axial direction is regulated at the other end of the shift cam section 109 by a second guide plate 109. Thus, when the rotating shift member 105 is operated by sliding rotation, the shift cam section 109 rotates around the axis of rotation Yb. A rotary cable coupling section 110 is formed at one end of the slide lever 106 by providing a freely rotating rotary cable coupling, and the inner cable 9a of the aforementioned shift cable 9 is coupled to this cable coupling section 110. A cam follower 111 is provided between the aforementioned cable coupling section 110 of the sliding lever 106 and the aforementioned axis of rotation Q, and the slide lever 106 is slidably biased, via the aforementioned inner cable 9a, by the self-recovering force of the shift device so that the aforementioned cam follower is normally in contact with the cam surface 109b of the shift cam section 109. The aforementioned cam surface 109b has the shape depicted in FIG. 11 when viewed along the aforementioned axis of rotation Xb. As the shift cam section 109 rotates, the slide lever 106 slides around the aforementioned axis of rotation Q so that the aforementioned inner cable is pulled in opposition to the self-recovering force of the shift device or is slackened so that the shift device is switched by self-recovering force.

The aforementioned shift cam surface 109b is provided with indented sections 109c corresponding in number to the number of speeds of the shift device, and the sliding lever 106 performs a slackening or pulling operation of specified stroke distance on the inner cable 9 so that the shift device is switched to the specified shift position, whereupon the aforementioned cam follower 111 enters the aforementioned indented section 109c which corresponds to this shift position. The engagement of the shift cam section 109 and the slide lever 106 produced by this entry positions the shift cam section 109 at the specified operating position to which it has been rotated, maintaining the shift position to which the shift device has been switched. Thus, when the rotating shift member 105 is operated by sliding rotation, the shift control device 100 pulls or slackens the inner cable of the shift cable 9 by this operating physical force so that the shift device is switched to the specified speed level.

The distance L1 from the axis of rotation Q of the aforementioned shift lever 106 to the center of the wiring coupling of the cable coupling section 110 is greater than the distance L2 from the axis of rotation Q to the cam section contact point of the cam follower 111. Thus, the stroke distance over which the inner cable 9a moves in the tensing direction or the slackening direction produced by the slide of the slide lever 106 is long in proportion to the angle of the slide operation of slide lever 106 by the shift cam section 109. That is, despite the small size of the shift cam section 109 and the compactness of the shift control device 100, it is still possible for the inner cable 9a to move over the stroke distance required for shifting.

As depicted in FIG. 12, a striking member 112 consisting of an elastic body affixed within the aforementioned mounting bracket 103 and a struck section 113 formed on the rotary cam member that constitutes the aforementioned shift cam section 109 together comprise a noise-making mechanism 114 for indicating shifting. Specifically, the struck section 113 is provided with depressions 113a corresponding in number to the number of speeds of the shift device and is designed so that when the shift cam section 109 is in a given operating position, the striking action protruding section 112a of the striking member 112 is aligned with the aforementioned depression 113a that corresponds to this operating position. When a shift operation is performed and the shift cam section 109 rotates, the struck section 113 rotates as well, and in association with this action, the striking action protruding section 112a of the striking member 112 rides up on the protruding sections 113b of the struck

member 113 so that the striking member 112 experiences elastic deformation. As the shift cam section 109 continues to rotate to a specified operating position, the striking action protruding section 112*a* slides over a protruding section 113*b* of the struck member 113 and falls into an adjacent depression 113*a*, and the elastic recovery force of the striking member 112 produced by elastic deformation up to this point causes the striking action protruding section 112*a* to come into contact with the depression 113*a* in striking fashion. Thus, when a shift operation is performed and the shift position of the shift device is shifted, the noise-making mechanism 114 emits a noise produced by contact of the striking member 112 and the depression 113 indicating the shifting of the shift device.

As shown in FIGS. 9 and 10, the aforementioned mounting bracket 103 is provided with a speed indicator section in which indicator windows 118*a*, provided in a number corresponding to the number of speeds of the shift device, are lined up in the direction of rotation of a rotating grip, and a speed indicator drum 115 is formed at one end of the inner sleeve 105 of the aforementioned rotating shift member 105, constituting a speed indicator mechanism. Specifically, when a shifting operation is performed and the rotating shift member 105 is slid, the accompanying rotation of the speed indicator drum 115 transports a color band member 115*a*, formed by applying a sticker to the speed indicator drum 115, along the inside of the row of indicator windows. When the device is shifted to a given shift position, as in the case when the shift device has been shifted to the third speed depicted in FIG. 13, the interiors of a number of indicator windows 118 corresponding to the ranking of the shift position to which the shift device has been shifted change from the color of the section of the speed indicator drum 115 other than the color band member 115*a* to the color of the color band member 115*a*. Specifically, as the shift device is upshifted from the lowest speed, the window interiors sequentially change color to the color of the color band member 115*a*, beginning with the indicator window 118 located at the end of the indicator window row and corresponding to the lowest speed. Thus, the number of colored indicator windows, counted from the low speed end of the indicator window row, indicates the current shift position of the shift device.

The mounting screw 116 depicted in FIG. 11 serves to fasten the lid member section 103*b* that covers the aperture provided in the aforementioned mounting bracket 103 for coupling the slide lever 106 and the inner cable 9*a* to the main body of the mounting bracket 103. One end of a coil spring 117, depicted in FIG. 10, is retained by the mounting bracket 103 while the other end is retained by the inner sleeve 105*b* of the rotating shift member 105. When the rotating shift member 105 is slid so as to pull the inner cable 9*a*, it biases the rotating shift member 105, becoming partially transformed into operating physical force, thus facilitating manual operation.

FIG. 14 is a plan view illustrating another embodiment of a bicycle shift control device according to the present invention. This embodiment is similar to the embodiment shown in FIG. 1, but in this case the axis of rotation Yb of the rotating shift member 105 and the axis of rotation W of the winder member 206 are different. Specifically, the axis of rotation W of the winder member 206 is positioned substantially perpendicular to the handlebar axis. This structure requires deflected force transmission means 210, located between the clutch gear 211 which receives the sliding displacement of the rotating shift member 105 via the clutch pawl and the winder member 206, for transmitting the rotational force of the rotating shift member 105 to the winder member 206, which is not positioned concentrically. This deflected force transmission means 210 comprises a first bevel gear 211 located at the edge of the clutch gear 211, a first intermediate gear 212 provided with a bevel gear section that meshes with the first bevel gear 211 and a flat gear section, a second intermediate gear 213 that meshes with the flat gear section of the first intermediate gear 212, and a gear section 214 that meshes with the aforementioned second intermediate gear 212 and that is formed on the peripheral surface of the aforementioned winder member.

The structure of the clutch pawl and the clutch gear 211, the full return stop mechanism and the position mechanism provided to the periphery of the winder member 206, and the structure of the shift lever 208 are the same as in the first embodiment, so a repetition of the previous description is omitted here.

FIG. 15 is a plan view illustrating another embodiment of a bicycle shift control device according to the present invention. In this embodiment, which is similar to the embodiment shown in FIG. 9, the width of the rotating shift member 305 is smaller, and the peripheral surface of the rotating shift member 305 is provided with a first finger-operated member 306 and a second finger-operated member 307 as a substitute.

The rotating shift member 305 is constituted so as to rotate back to the home position due to a return spring. When the first rotating shift member 305 is positioned at the home position, the first finger-operated member 306 and the second finger-operated member 307 are positioned at home positions N1 and N2, depicted in FIG. 16. Specifically, the home position N2 of the second finger-operated member 307 is located at a higher level than is the home position N1 of the first finger-operated member 306. Thus, the use of the first finger-operated member 306 is relatively easier when shifting by one speed only, as less lifting of the finger is required than when the second finger-operated member 307 is used. The use of the second finger-operated member 307 is relatively easier when shifting over a predetermined plurality of speeds (two or more speeds) in a single shifting operation, as a rotation operation entailing a relatively large angle of rotation of the first rotating shift member 5 is easier than with the first finger-operated member 306. Thus, accurate operation, despite the necessity to rotate the winder member 206 over a plurality of rotation pitches, is possible.

The rotating shift member need not be a complete ring member. Instead, the rotating shift member 405 can comprise a partial ring member in which a section has been cut out, as depicted in FIG. 17.

While the above is a description of various embodiments of the present invention, it is clear that many modifications may be employed and still be within the spirit and scope of the present invention. For example, the specific structures described in the various embodiments can be used in any combination, and these combinations are also included within the scope of the present invention. While an angle of inclination of 5° was given as an example, an angle of between approximately 5° and 40° may be desirable, depending upon the application. Thus, the scope of the invention should not be limited by the specific structures disclosed. Instead, the scope of the present invention should be determined by the following claims. Of course, although labelling symbols are used in the claims in order to facilitate reference to the figures, the present invention is not intended to be limited to the constructions in the appended figures by such labelling.

What is claimed is:

1. A bicycle shift control device comprising:

a guide member (4,104) for mounting coaxially with a longitudinal axis (Xb) of a handlebar of a bicycle; and

a rotatable shift member (5,105,205,305,405) guided by the guide member (4,104) for rotation around the axis (Xb) of the handlebar and coaxially with a rotational axis (Yb);

wherein the rotational axis (Yb) of the shift member (5,105,205,305,405) is inclined relative to the axis (Xb) of the handlebar.

2. The device according to claim 1 wherein the rotatable shift member (5,105,205,305,405) comprises a ring member (5,105,205,305) that surrounds both the axis (Xb) of the handlebar and the rotational axis (Yb).

3. The device according to claim 2 wherein the ring member (5,105,205,305) moves over a path (4*b*,104*b*) formed by the guide member (4,104).

4. The device according to claim 1 wherein the rotatable shift member (5,105,205,305,405) comprises a partial ring member (405) that curves around both the axis (Xb) of the handlebar and the rotational axis (Yb).

5. The device according to claim 4 wherein the ring member (405) moves over a path (4*b*,104*b*) formed by the guide member (4,104).

6. The device according to claim 1 wherein the rotatable shift member (305,405) comprises at least one finger-operated member (306,307) which extends outwardly from the rotatable shift member (305,405).

7. The device according to claim 1 wherein the rotatable shift member (305,405) comprises a first finger-operated member (306) and a second finger-operated member (307), each of which extends outwardly from the rotatable shift member (305,405) at a prescribed spacing from each other.

8. The device according to claim 1 further comprising:

a cable shift member (106) for coupling to a shift cable; and

a transmission mechanism (109,111) that transmits displacement of the rotatable shift member to the cable shift member (106).

9. The device according to claim 8 wherein the cable shift member comprises a slide lever (106) pivotally coupled to the shifting device at one end and to the shift cable at another end, and wherein the transmission mechanism comprises:

a cam (109) coupled for rotation in response to rotation of the rotatable shift member (105); and

a cam follower (111) coupled to the slide lever (106).

10. The device according to claim 1 further comprising a winding member (6) for attachment to a shift cable, the winding member (6) being coupled for coaxial rotation about the rotational axis (Yb) of the shift member (5,105,205,305,405) in response to rotation of the rotatable shift member (105).

11. The device according to claim 10 further comprising a one-way clutch (20) coupling the rotatable shift member (5) to the winding member (6).

12. The device according to claim 1 further comprising:

a winding member (206) for attachment to a shift cable, the winding member being coupled for rotation about an axis (W) that is oriented differently from the rotational axis (Yb) of the shift member (5,105,205,305,405); and

transmission means (210) for transmitting rotational force from the rotatable member (205) to the winding member (206).

13. The device according to claim 12 wherein the transmission means comprises a gear transmission mechanism (211,212,213,214).

14. The device according to claim 1 further comprising:

a shift lever (8);

a winding member (6) for attachment to a shift cable;

a clutch (20) for coupling rotation of the rotatable shift member (5) to the winding member (6) in a first rotational direction; and

an interlink mechanism (30) coupled to the shift lever (8) and to the winding member (6) for causing the winding member (6) to move in a second rotational direction in response to movement of the shift lever (8).

15. The device according to claim 14 wherein a direction of displacement of the rotatable shift member (5) is different from a direction of displacement of the shift lever (8).

16. The device according to claim 1 wherein the rotational axis (Yb) of the shift member (5,105,205,305,405) is inclined about a vertical axis.

17. The device according to claim 16 wherein an angle of inclination (α) between the axis (Xb) of the handlebar and the rotational axis (Yb) of the shift member (5,105,205,305,405) is from approximately 5° to approximately 40°.

18. A bicycle shift control device comprising:

a rotatable shift member (5,105,205,305,405);

a guide member (4,104) including a mounting hole for mounting the guide member (4,104) around the perimeter of a handlebar coaxially with a longitudinal axis (Xb) of the handlebar and a guide surface (4*b*, 104*b*) for determining a displacement path of the rotatable shift member (5,105,205,305,405) around the axis (Xb) of the handlebar and coaxially with a rotational axis (Yb); and

wherein the rotational axis (Yb) of the rotatable shift member (5,105,205,305,405) is inclined relative to the axis (Xb) of the handlebar.

19. A bicycle shift control device comprising:

a guide member (4,104) for mounting to a handlebar of the bicycle, the guide member (4,104) having an inner peripheral surface (4*a*, 104*a*) oriented substantially coaxially with a longitudinal axis (Xb) of the handlebar and an outer peripheral surface (4*b*, 104*b*) coaxial with a rotational axis (Yb), wherein the rotational axis (Yb) is inclined relative to the axis (Xb) of the handlebar; and

a rotatable member (5,105,205,305,405) guided by the outer peripheral surface (4*b*,104*b*) of the guide member (4,104) for rotation around the axis (Xb) of the handlebar and coaxially with the rotational axis (Yb).

20. The device according to claim 19 wherein the rotatable member (5,105,205,305,405) includes an inner peripheral surface (5*b*,105*b*) which opposes the outer peripheral surface (4*b*,104*b*) of the guide member (4,104).

21. The device according to claim 20 wherein the inner peripheral surface (5*b*,105*b*) of the rotatable member (5,105,205,305,405) is in sliding contact with the outer peripheral surface (4*b*,104*b*) of the guide member (4,104).

* * * * *

US006095309A

United States Patent [19]

Mione

[11] **Patent Number: 6,095,309**

[45] **Date of Patent: Aug. 1, 2000**

[54] **CYCLE HANDLEBAR ACTUATOR**

[75] Inventor: **Walter Mione**, Scarborough, Canada

[73] Assignee: **At Design Inc.**, Scarborough, Canada

[21] Appl. No.: **09/190,163**

[22] Filed: **Nov. 12, 1998**

[51] **Int. Cl.**[7] **B62K 11/14**; B62L 3/02; B62M 25/04

[52] **U.S. Cl.** **192/217**; 74/110; 74/473.14; 74/422; 74/489; 74/502

[58] **Field of Search** 74/488, 489, 110, 74/422, 502, 473.14; 192/217

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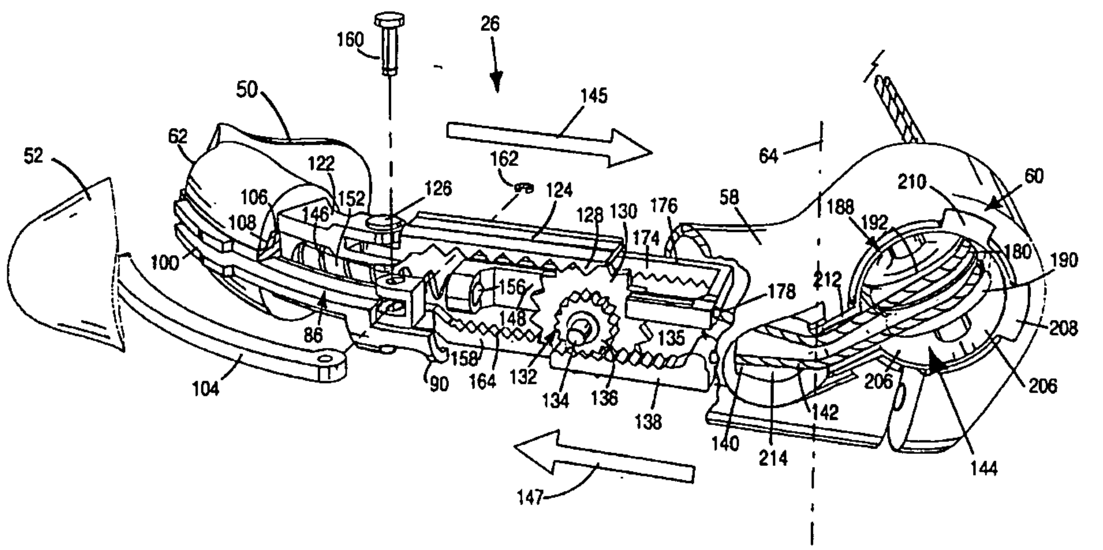
Primary Examiner—Allan D. Herrmann
Attorney, Agent, or Firm—Ingrid E. Schmidt

[57] **ABSTRACT**

An actuator for actuating a derailleur and/or a brake of a bicycle. The actuator is incorporated into a bar end and includes a lever slidably mounted to the bar end for sliding between a neutral position and an actuating position axially spaced from the neutral position. A transmission mechanism is received within a cavity of the bar end and couples the lever to the brake or derailleur. The transmission mechanism actuates the brake or derailleur when the lever is slid to the actuating position.

7 Claims, 13 Drawing Sheets



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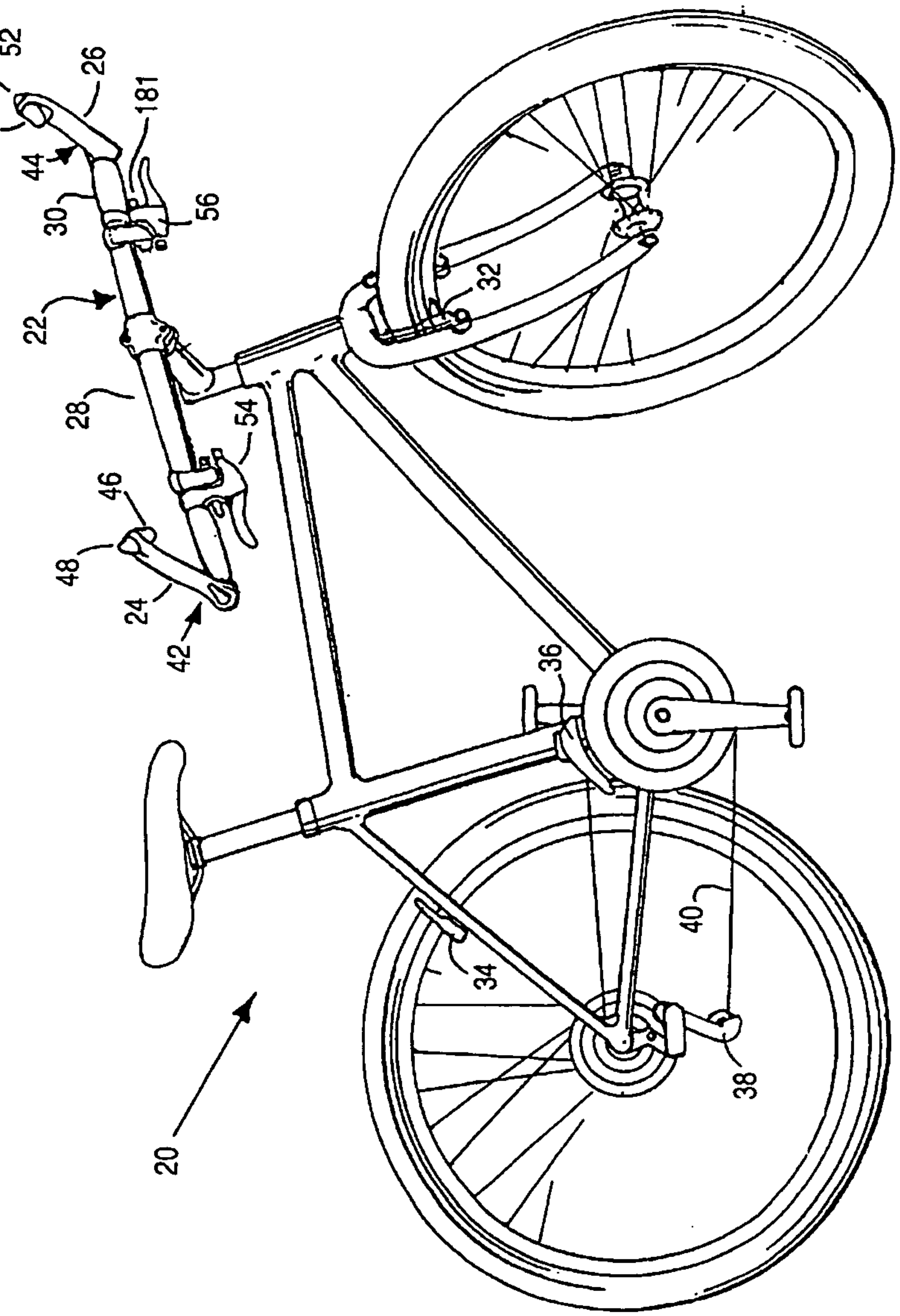


FIG. 1

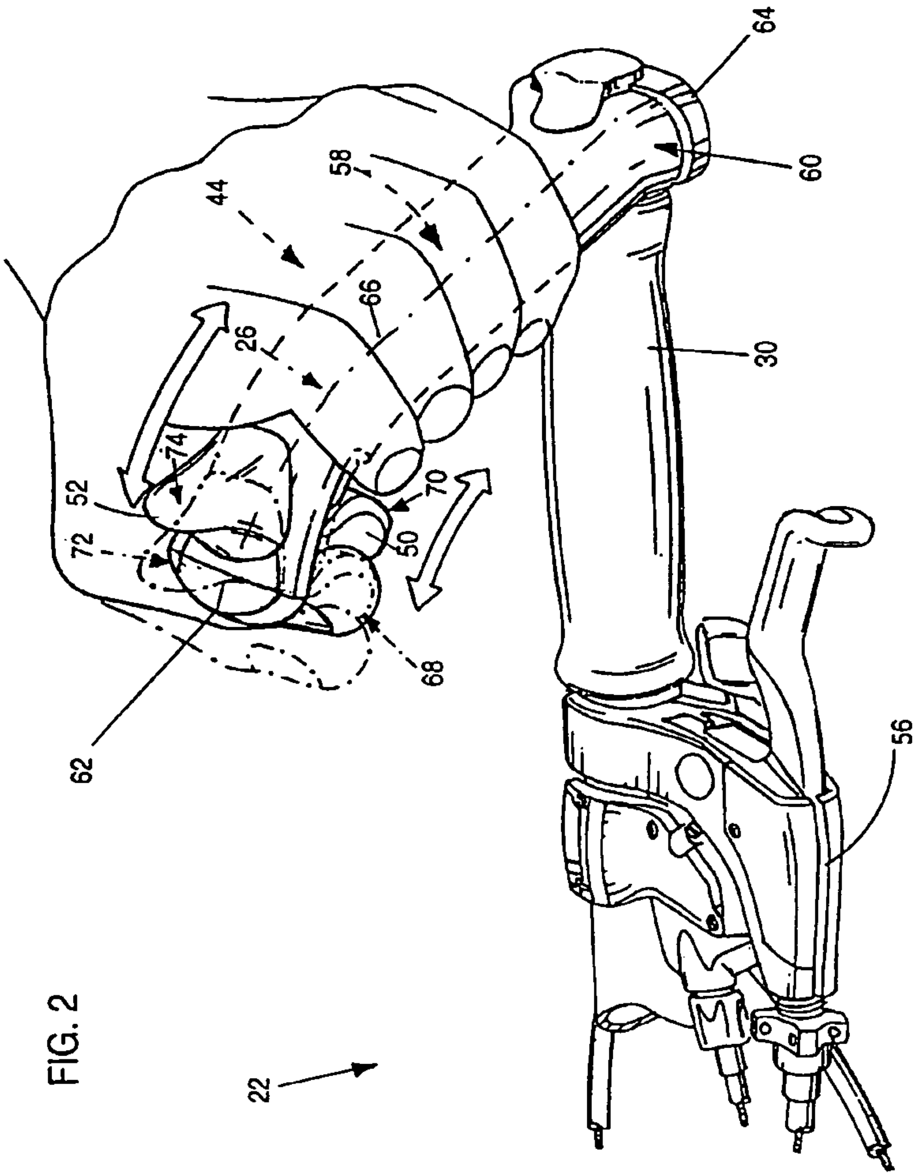
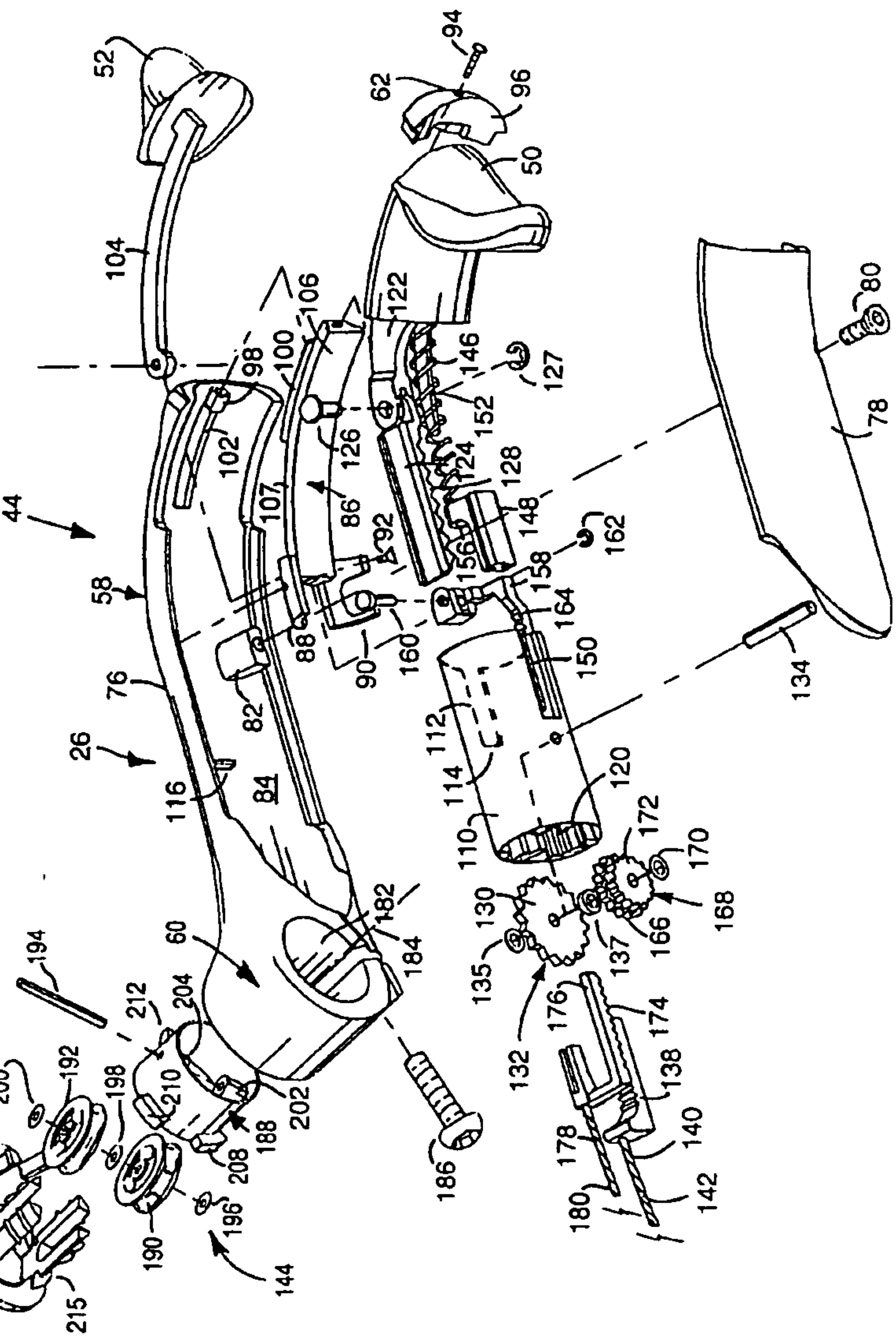


FIG. 2

FIG. 3



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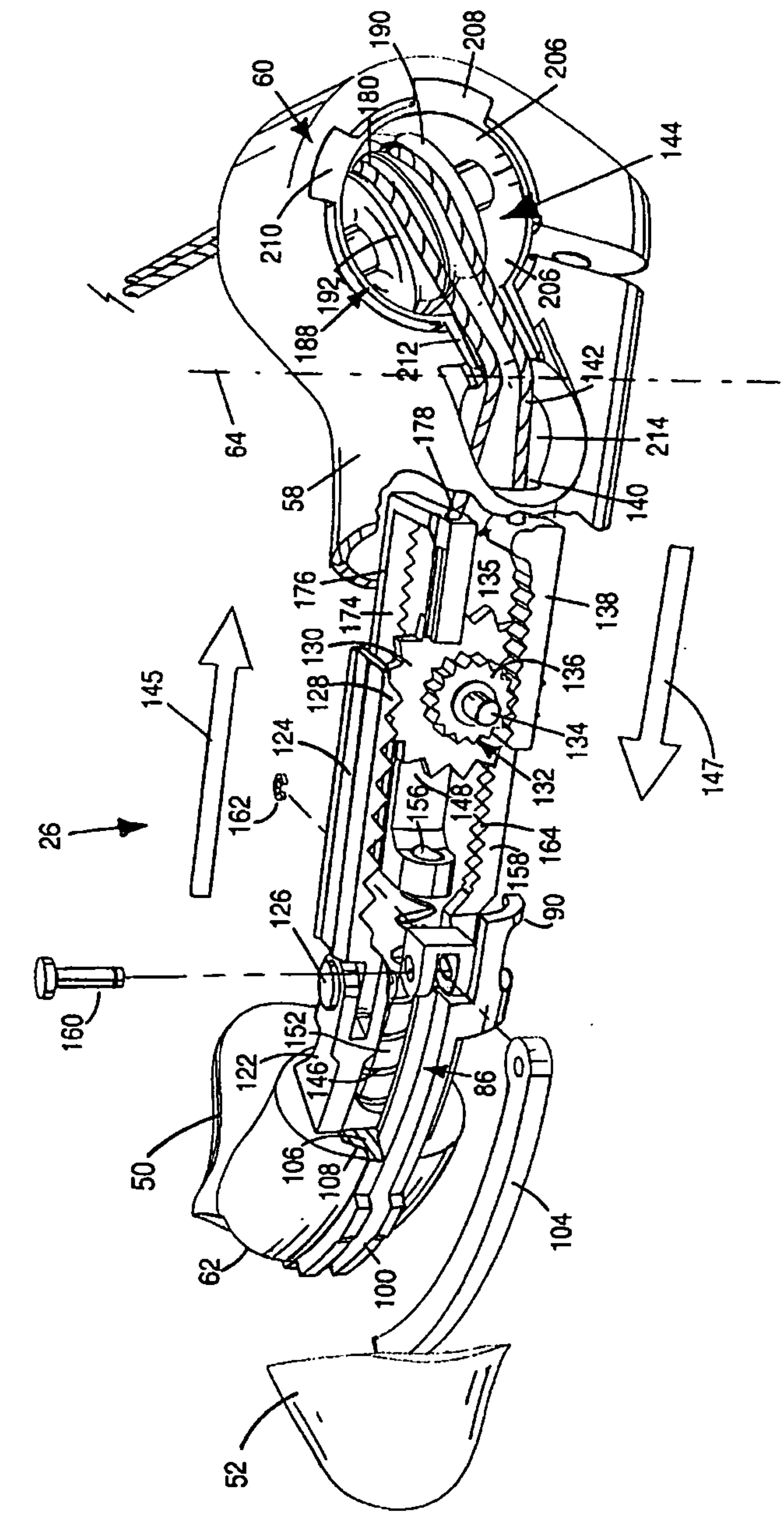
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FIG. 4

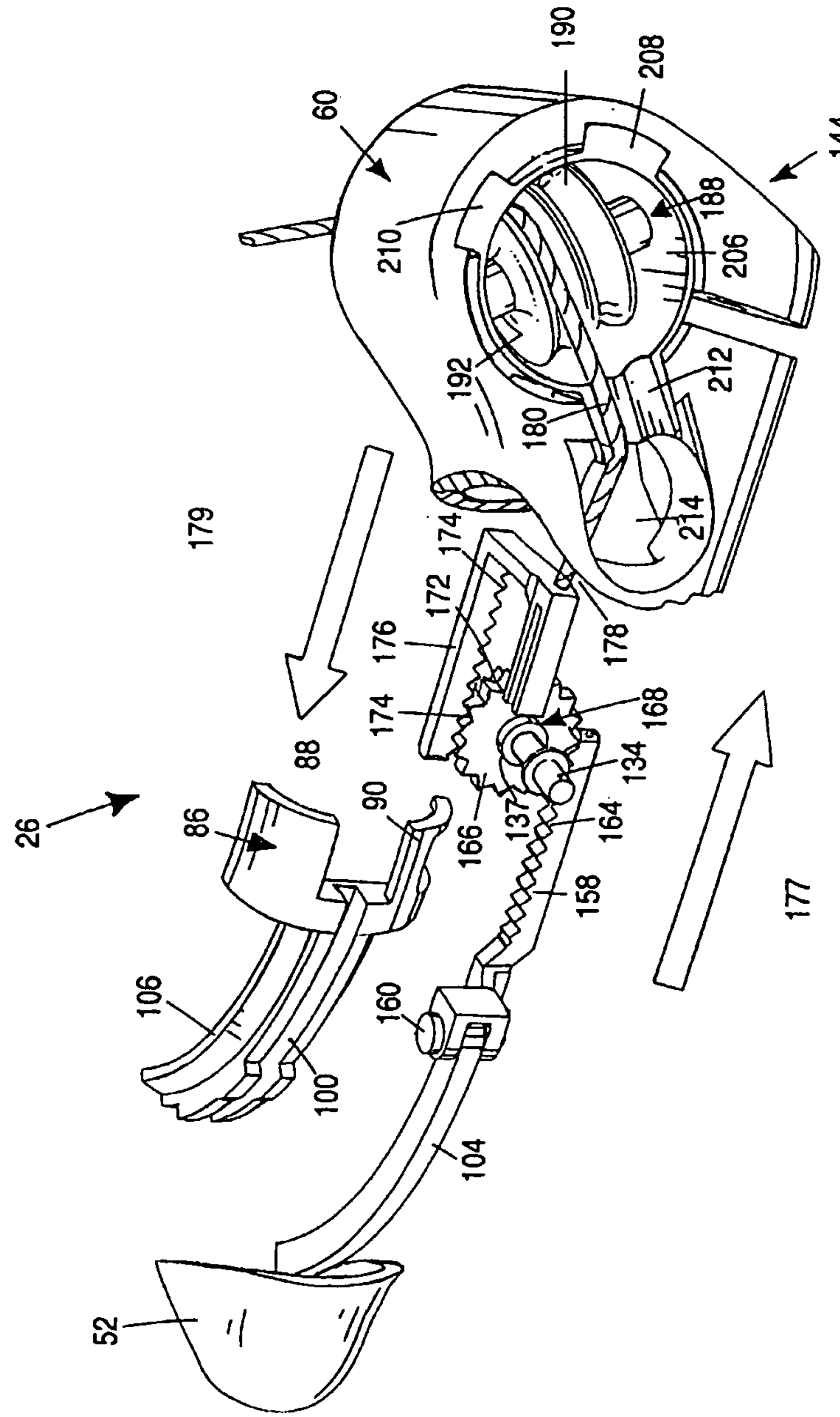

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FIG. 5

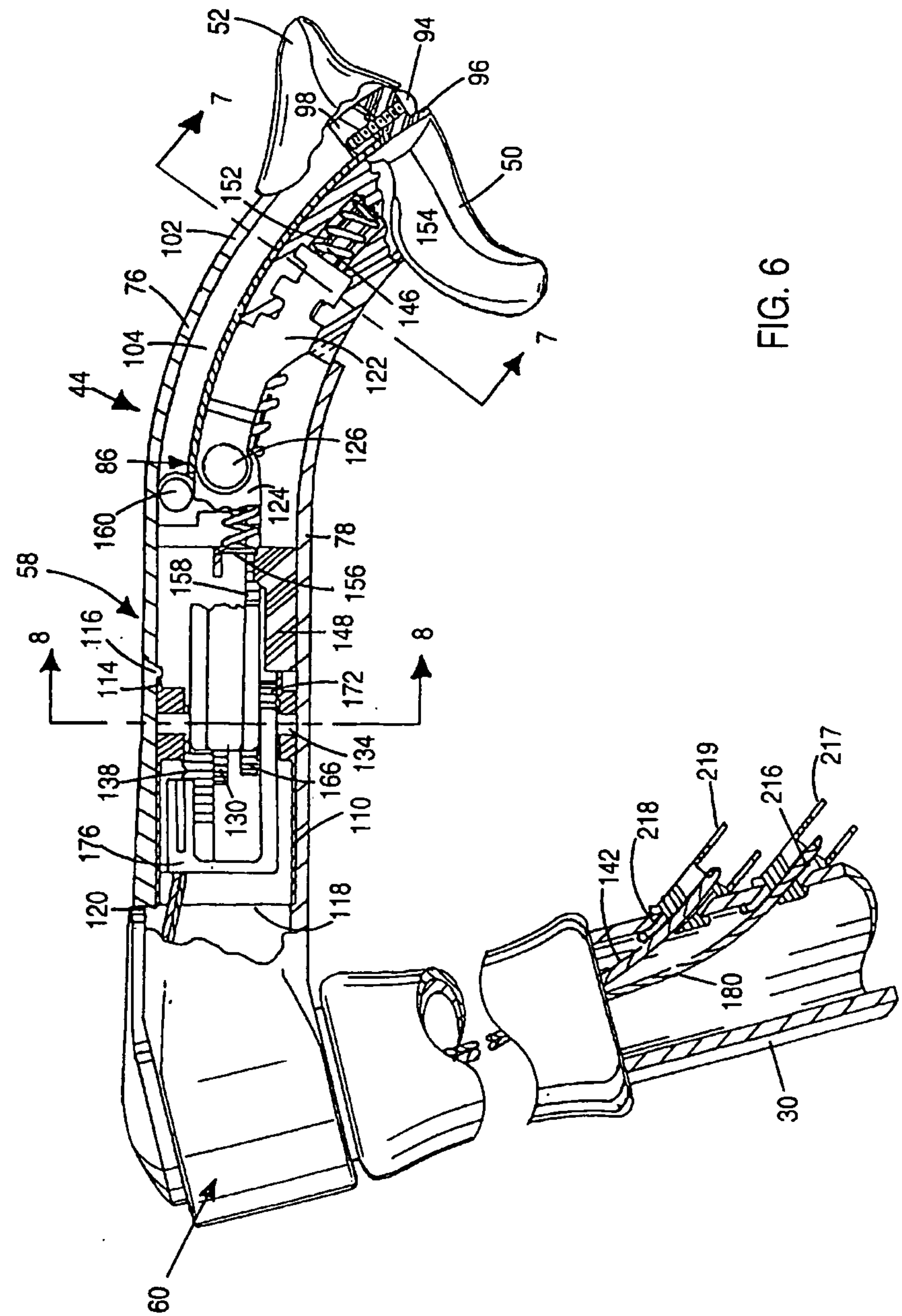
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FIG. 6

FIG. 7

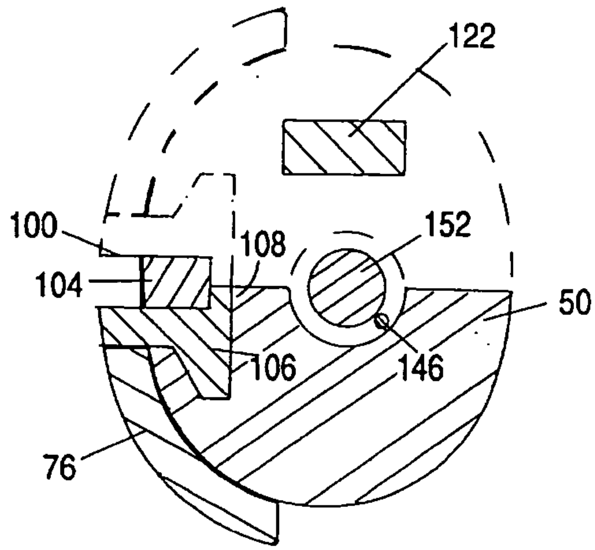
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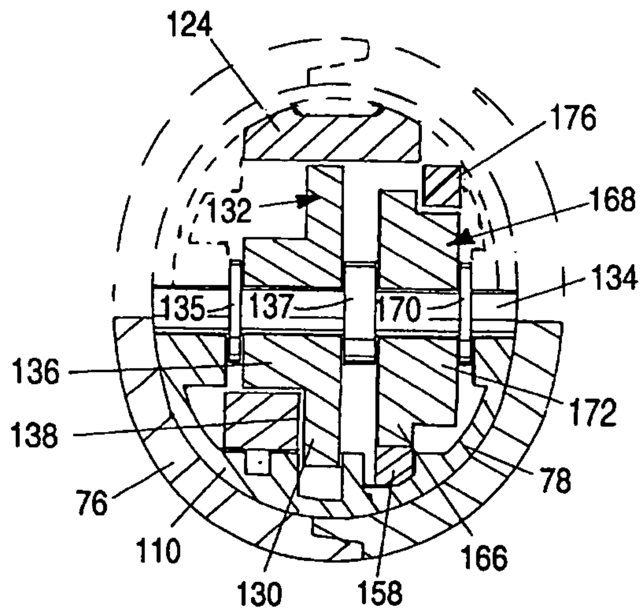
FIG. 8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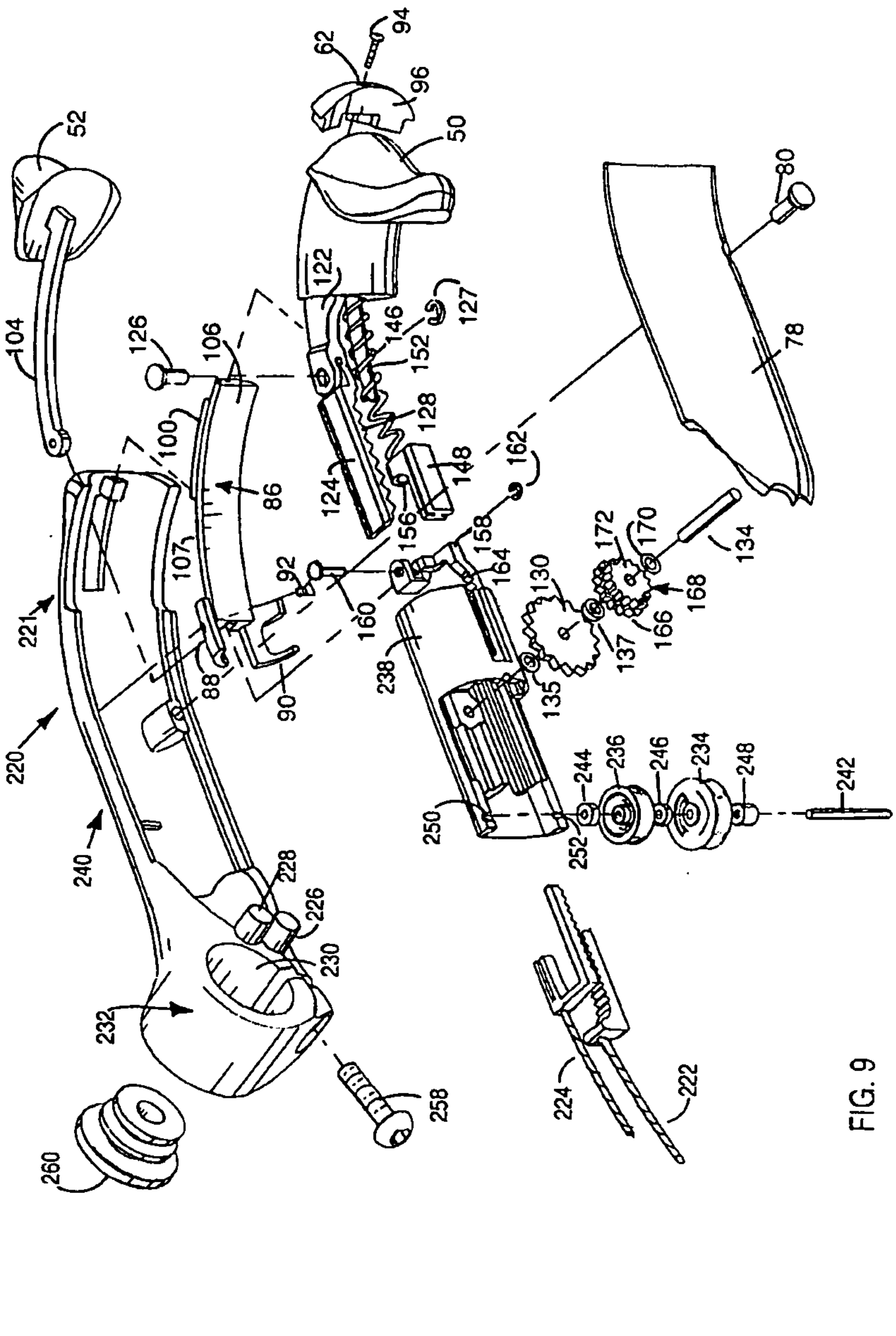
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FIG. 9

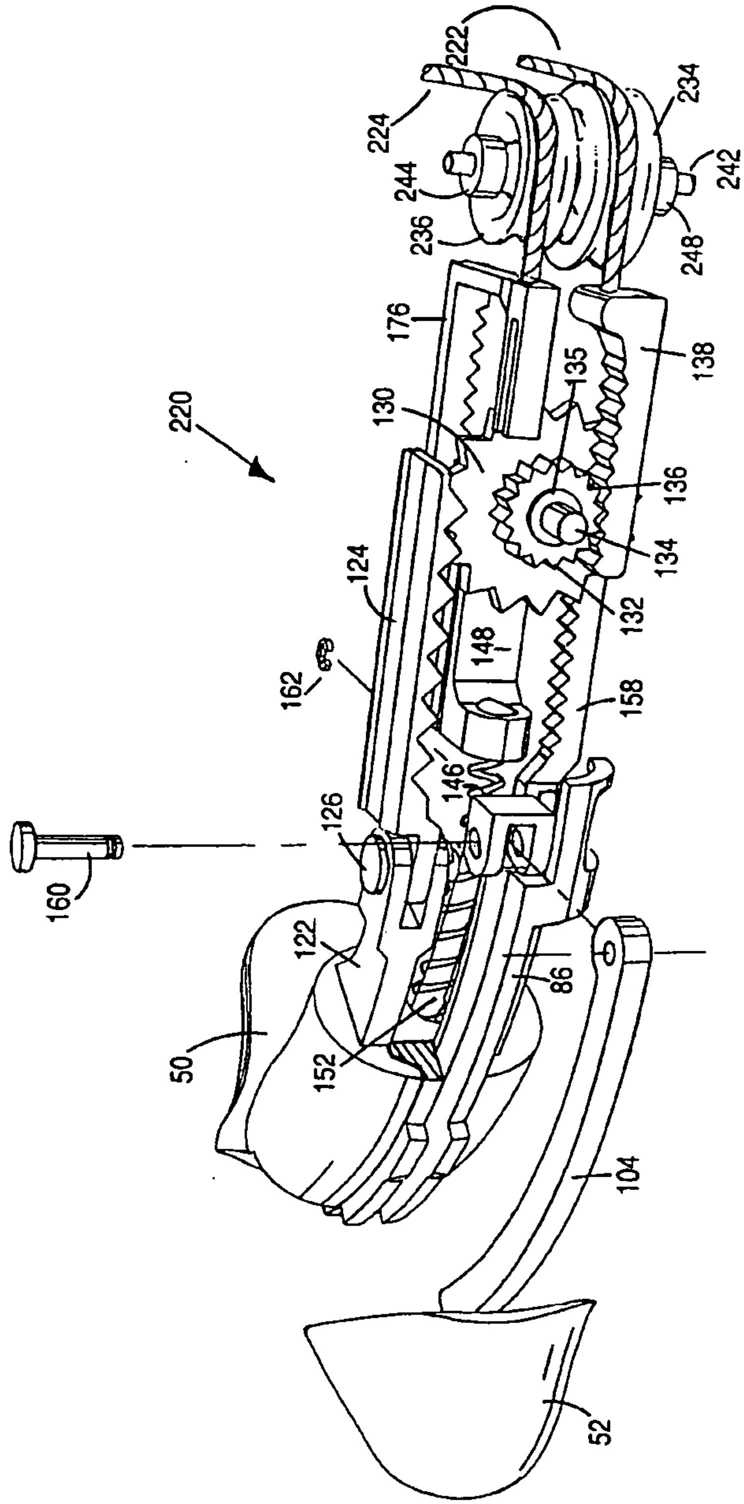
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FIG. 10

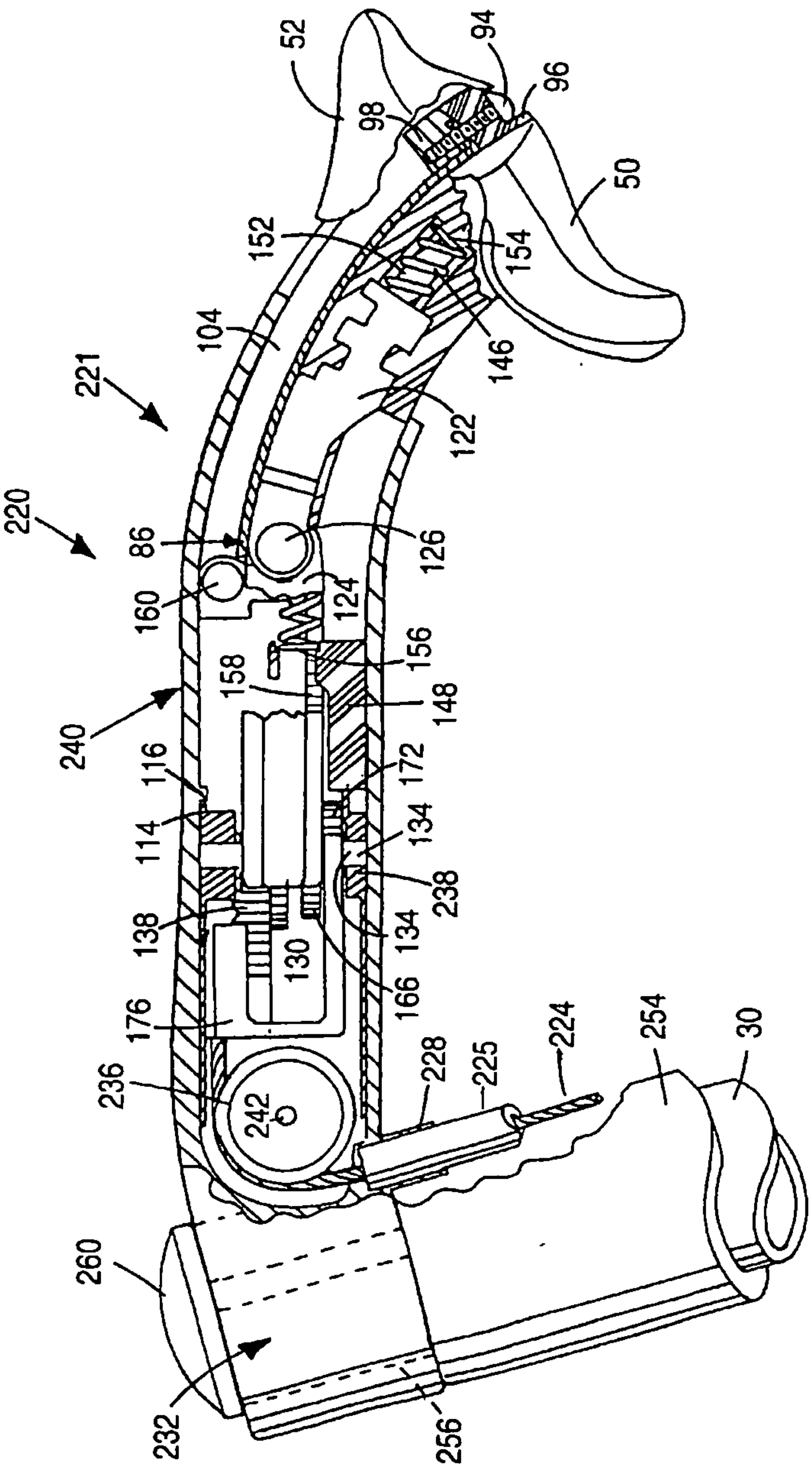
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FIG. 11

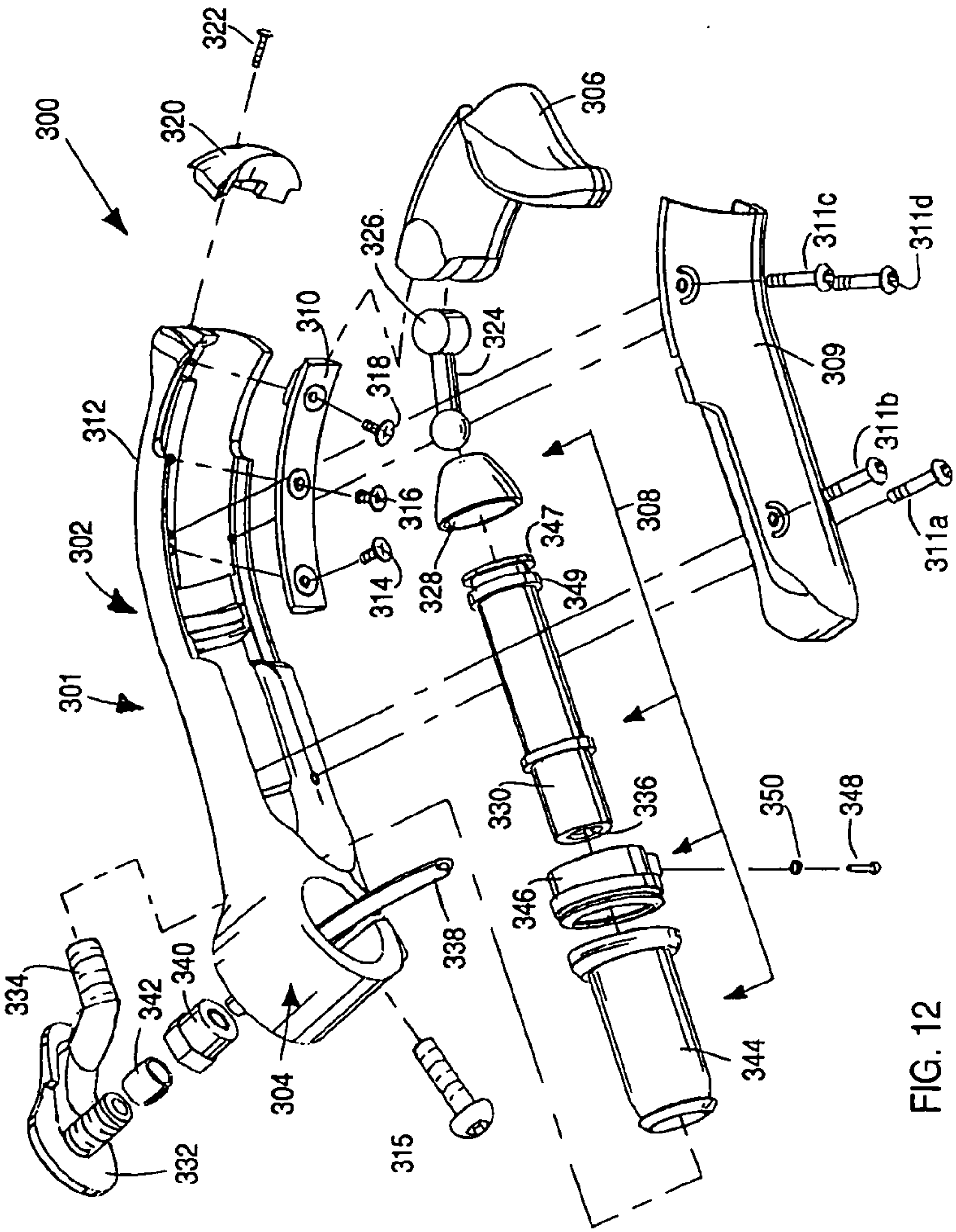
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FIG. 12

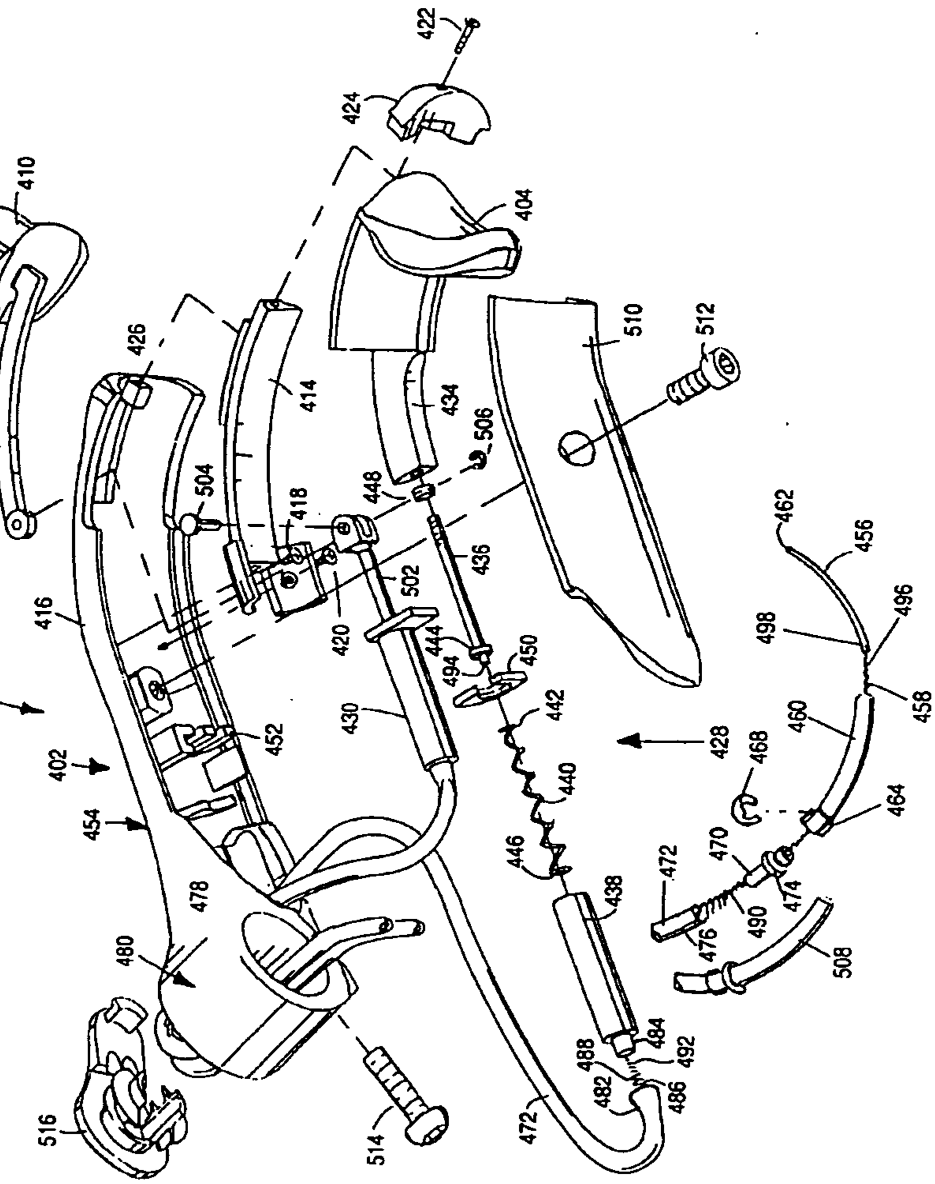
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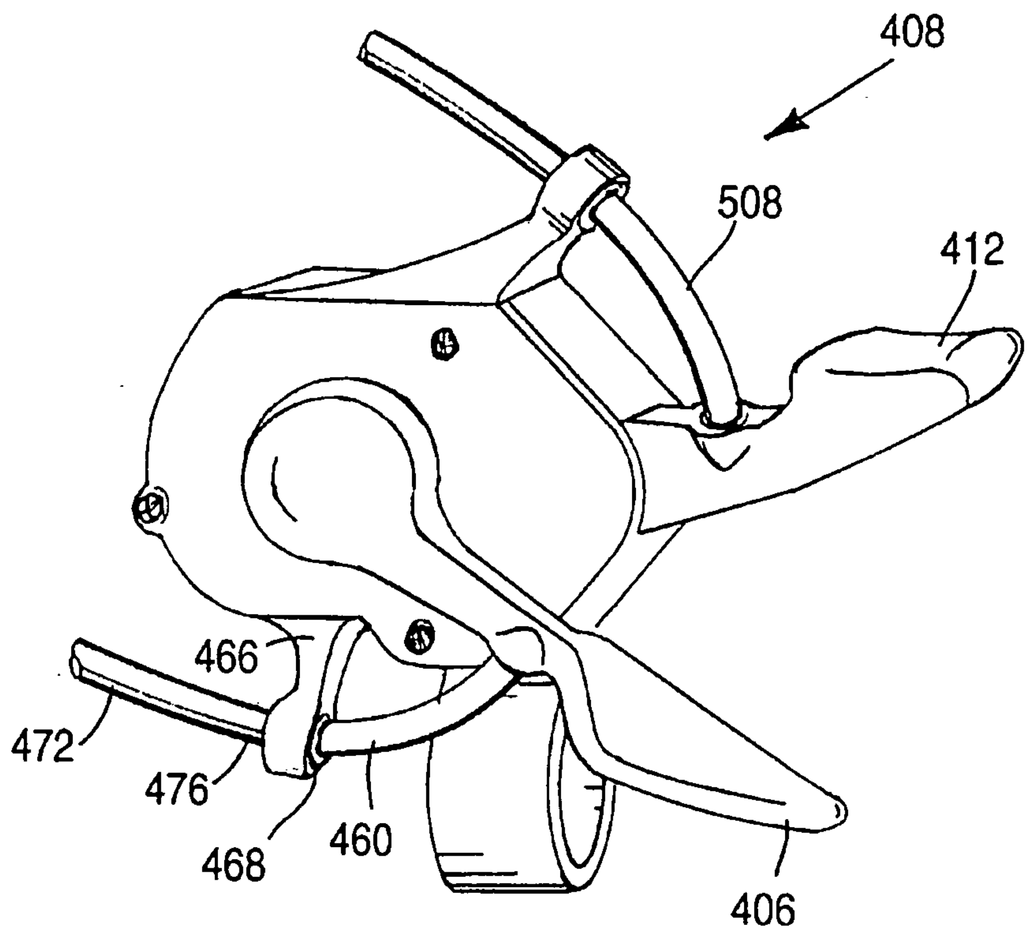
FIG. 13

FIG. 14



CYCLE HANDLEBAR ACTUATOR

FIELD OF THE INVENTION

The present invention relates to cycles and, more particularly, to actuators for attachment to a cycle handlebar for operating a cycle brake and/or a cycle derailleur.

BACKGROUND OF THE INVENTION

Cycles include bicycles, tricycles, tandem bicycles, and mopeds. Many cycles, such as mountain bicycles, are equipped with handlebar systems, each of which include a central, generally outwardly-extending portion to be referred to herein as handlebars, and handlebar extensions connected to respective outer ends of the handlebars to be hereinafter referred to as bar ends.

Such handlebar systems allow for generally two riding positions. A first position entails gripping the handlebars to achieve superior steering control and enhanced riding stability. A second position entails placing the hands on the bar ends to obtain increased leverage when ascending hills, as well as a more comfortable riding position when cycling across level terrain.

Conventional brake and shift levers are commonly mounted to the handlebars allowing for quick and convenient braking or shifting when the hands are gripping the handlebars but not when the hands are grasping the bar ends. In the latter position, balance, control, response time, and hence rider safety, are compromised by the need to remove a hand from a bar end to reach a desired brake or shift lever on a handlebar.

U.S. Pat. No. 5,094,322 to Casillas shows brake levers mounted to both a bar end and a handlebar, thereby allowing for convenient and safe braking in any cycling position. However, the problem of shifting gears when riding with the hands on the bar ends is not addressed.

U.S. Pat. No. 5,678,455 to Watarai and U.S. Pat. No. 5,315,891 to Tagawa show shifting devices mounted to a bar end and a handlebar respectively; however, the problem of braking when the hands are gripping the bar ends is not addressed.

There is therefore a need to provide a new and improved actuator which, in accordance with one of its aspects, is adapted to actuate a cycle brake and a cycle derailleur, and which, in accordance with another of its aspects, is mountable to a bar end of a conventional cycle so that convenient and safe braking and shifting can be achieved in any cycling position.

SUMMARY OF THE INVENTION

The invention provides an actuator for actuating a cycle speed change member consisting of a derailleur or a brake. The actuator is incorporated into a generally cylindrical elongate member which is adapted to form part of a cycle handlebar system. The elongate member has a cavity, first and second ends, and a longitudinal axis extending between the first and second ends. The actuator includes an operating device slidably mounted to the elongate member for sliding between a neutral position and an actuating position axially spaced from the neutral position, and further includes a transmission mechanism received within the cavity of the elongate member, coupled to the operating device, and adapted to be coupled to a speed change member. The transmission mechanism is further adapted to actuate the speed change member when the operating device is in the actuating position.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention will now be described with reference to the drawings in which,

FIG. 1 is a simplified perspective view of a bicycle to which are mounted a pair of actuators according to a first embodiment of the invention, the actuators being incorporated into respective bar ends of a handlebar system of the bicycle;

FIG. 2 is a partial perspective view of the handlebar system showing a left actuator being operated by a thumb of a rider;

FIG. 3 is an exploded perspective view of the left actuator as seen from an inner side;

FIG. 4 is a perspective view of the left bar end as seen from an outer side, with portions removed or broken away to show internal structure;

FIG. 5 is a view similar to the view of FIG. 4 of the left bar end with additional portions removed to show other features of internal structure;

FIG. 6 is a top view of part of the handlebar system, partially sectioned and with portions broken away to show internal structure;

FIG. 7 is a section of the actuator taken along line 7—7 of FIG. 6;

FIG. 8 is a section of the actuator taken along line 8—8 of FIG. 6;

FIG. 9 is a view similar to the view of FIG. 3 of an actuator according to a second preferred embodiment of the invention;

FIG. 10 is a view similar to the view of FIG. 4 of the actuator of FIG. 9;

FIG. 11 is a view similar to the view of FIG. 6 of the actuator of FIG. 9;

FIG. 12 is a view similar to the view of FIG. 3 of an actuator according to a third preferred embodiment of the invention;

FIG. 13 is a view similar to the view of FIG. 3 of an actuator according to a fourth preferred embodiment of the invention; and

FIG. 14 is a perspective view as seen from a bottom of a simplified Shimano XTR™ shifter modified to receive push rods of the actuator of FIG. 13.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the present specification, directional indicators including the words "right", "left", "forward", "rearward", "upper", and "lower", are used with reference to the bicycle and shall not be construed as limiting the scope of the invention as hereinafter claimed.

Referring to FIG. 1, a bicycle designated generally by reference numeral **20** is shown. The bicycle **20** includes a handlebar system designated generally by numeral **22** which includes forwardly-extending generally cylindrical elongate members in the form of right and left bar ends **24**, **26** and outwardly-extending right and left handlebars **28**, **30**. The bicycle **20** is equipped with cycle speed change members in the form of conventional front and rear brakes **32**, **34** and front and rear derailleurs **36**, **38**. The derailleurs **36**, **38** operate a conventional chain **40** to change gears.

Right and left actuators according to a first preferred embodiment of the invention and designated generally by reference numerals **42**, **44**, respectively, for actuating the

brakes 32, 34 and derailleurs 36, 38, are incorporated into respective bar ends 24, 26, in a manner as will be described. The right actuator 42 includes operating devices in the form of a thumb-operated brake lever 46 for actuating the rear brake 34 and a thumb-operated shift lever 48 for downshifting rear derailleur 38. Similarly, left actuator 44 includes operating devices in the form of a thumb-operated brake lever 50 for actuating the front brake 32 and a thumb-operated shift lever 52 for downshifting the front derailleur 36. It should be noted that, in this embodiment, no provision is made for upshifting.

The actuators 42, 44 permit convenient braking and downshifting when a cyclist's hands are on the bar ends 24, 26. When the hands are on the handlebars 28, 30, braking and shifting may be conveniently accomplished using Shimano XTR™ brake and shift lever units 54, 56 mounted on respective handlebars 28, 30. Thus braking and downshifting may be achieved safely and conveniently in any riding position.

The left actuator 44 which is similar to the right actuator 42 will now be described in detail.

FIG. 2 shows a hand operating the left actuator 44. The bar end 26 includes a grip portion 58 including a forward first end 62 of the bar end 26. Integrally formed with the grip portion 58 is a handlebar attachment portion 60 designed to receive an outer end of the left handlebar 30 as will be described below, and which includes a rearward second end 64 of the bar end 26. A longitudinal axis 66 extends between the first and second ends 62, 64. The brake lever 50 is slidably mounted to the grip portion 58 for sliding between a brake neutral position 68 at the first end 62 and a brake actuating position 70 spaced from the neutral position 68 along axis 66 of the grip portion 58. A brake transmission mechanism, to be described below, is received within a cavity of the bar end 26 and coupled to each of the brake lever 50 and to the front brake 32. The brake transmission mechanism is adapted to actuate the front brake 32 (FIG. 1) when the thumb brake lever 50 is in the brake actuating position 70.

Similarly, the thumb shift lever 52 is slidably mounted to the grip portion 58 for sliding between a shift neutral position 72 at the first end 62 and a shift actuating position 74 axially spaced from the shift neutral position 72. A shift transmission mechanism, also to be described below, is received within the cavity of the bar end 26 and is coupled to the thumb shift lever 52 and to the front derailleur 36, being adapted to downshift the front derailleur 36 when the shift lever 52 is in the shift actuating position 74.

The left actuator 44 will now be described in more detail with reference mainly to FIG. 3 but with reference also to other figures, as required.

FIG. 3 shows the left actuator 44 in an exploded view to reveal internal components, including the brake and shift transmission mechanisms. In order to provide a frame of reference for the moving parts, some parts which remain fixed in location within the grip portion 58 will first be described.

The bar end 26 includes a two-piece housing for containing the internal components. The housing has an outer housing member 76 and an inner housing member 78 which is secured to the outer housing member 76 using a threaded bolt 80. The bolt 80 is received by a complimentary threaded retainer 82 attached to an inner surface 84 of the outer housing member 76.

A guide rail designated generally by reference numeral 86 for guiding the motion of thumb brake lever 50 and thumb

shift lever 52 axially along the grip portion 58 is attached securely to the outer housing member 76 with wings 88, 90 of the guide rail 86 lying flush against the inner surface 84. The guide rail 86 is attached using a screw 92 which extends through the upper wing 88 into the outer housing member 76. The attachment is reinforced by a screw 94 which attaches an end bearing 96 to the guide rail 86, and the guide rail 86 to a screw receiver 98 formed integrally with the inner surface 84 adjacent to a forward end of the outer housing member 76.

A forward guide portion of the guide rail 86 includes a shift lever guide 100 formed on an outer side thereof which extends through a slot 102 of outer housing member 76 and receives and guides a shift lever arm 104 of the shift lever 52. An inner side of the guide portion of the guide rail 86 defines a brake lever guide 106 having a T-shaped cross-section (see also FIG. 7). The thumb brake lever 50 is provided with a complementary T-shaped recess 108 (see FIGS. 4 and 7) for slidably receiving the brake lever guide 106. Thus, the shift lever 52 and brake lever 50 slide along and are guided by respective guides 100 and 106 of the guide rail 86 between the respective neutral positions 72, 68 and respective actuating positions 74, 70.

A gear cartridge 110 for housing and/or guiding components of the shift and brake transmission mechanisms is sandwiched between inner and outer housing members 76, 78 such that movement of the gear cartridge 110 within the grip portion 58 is restricted. The gear cartridge 110 includes a left slot 112 having a slot end 114 abutting against a stop 116 formed integrally with inner surface 84 of outer housing member 76 such that forward travel of gear cartridge 110 within the grip portion 58 is further restricted. Referring to FIG. 6, rearward travel of the gear cartridge 110 is also further restricted by an annular abutment 118 of the grip portion 58 which is engaged by a rearward end 120 of the gear cartridge 110.

The operation of the brake lever 50 and brake transmission mechanism to cause braking of front brake 32 will now be described with reference mainly to FIGS. 3 and 4.

The brake lever 50 includes an integral rearwardly-extending brake lever arm 122 having a rearward end attached to the brake transmission mechanism which is in the form of a rack and pinion system. The rack and pinion system includes a first rack in the form of an upper brake rack 124 to which the brake lever arm 122 is pivotally attached by means of a pivot pin 126 and a pin retaining clip 127.

The upper brake rack 124 is slidable longitudinally within the gear cartridge 110 along corresponding inner guides (shown in section in FIG. 8) provided on an inner surface of the gear cartridge 110. Downwardly depending teeth 128 of the upper brake rack 124 cooperate with a large diameter brake pinion 130 of a brake step-down pinion assembly designated generally by reference numeral 132 rotatably mounted between bushings 135, 137 on a pinion pin 134 extending through the gear cartridge 110.

Referring now to FIG. 4, a small diameter brake pinion 136 is attached to and rotates with the large diameter brake pinion 132 about the pinion pin 134. The small diameter brake pinion 134 in turn cooperates with upwardly-extending teeth of a second brake rack in the form of a lower brake rack 138 which is also slidable on corresponding inner guides (shown in section in FIG. 8) of the gear cartridge 110. The lower brake rack 138 has a rearward end attached to a proximate end portion 140 of a speed control cable in the form of a brake cable 142. The brake cable 142 extends

through a cable guide arrangement designated generally by reference numeral 144 which receives and guides the brake cable 142 out of the left bar end 26, as will be described in more detail below. A remote end (not shown) of the brake cable 142 is connected to the front brake 32 in a conventional manner.

Thus, depressing the brake lever 50 axially rearwardly towards the brake actuating position 70 causes the upper brake rack 124 to slide rearwardly in the direction of arrow 145 with a corresponding forward movement of the lower brake rack 138 in the direction of arrow 147. The forward movement of the lower brake rack 138 into the gear cartridge 110, in turn, causes the brake cable 142 to be pulled into the cavity of the left bar end 26, away from and thereby actuating the front brake 32.

Referring again to FIG. 3, a biasing member in the form of a return spring 146 is coupled to and biases the brake lever 50 towards the brake neutral position 68. The return spring 146 has a rearward end coupled to the gear cartridge 110 by means of an L-shaped bracket member 148 which snaps onto a complementary bracket retainer portion 150 of the gear cartridge 110. The return spring 146 is slid over a spring slide 152 integral with and extending rearwardly from the brake lever 50. A forward end of the return spring 146 engages an abutment wall 154 of the brake lever 50 (See FIG. 6). When depressing brake lever 50 rearwardly towards the brake actuating position 70, the return spring 146 compresses and the spring slide 152 slides through the return spring 146 and through a circular slot 156 of the L-shaped bracket member 148, entering the gear cartridge 110. Upon release of the brake lever 50, the brake lever 50 travels forwardly under the action of the return spring 146 until the brake lever 50 contacts the end bearing 96 which functions as an end stop to prevent the brake lever 50 from being detached from the actuator 44. The end bearing 96 further functions as a thumb rest during cycling.

The shift lever 52 and shift transmission mechanism function much in the same way as the brake lever 50 and brake transmission mechanism, and will now be described with reference to FIGS. 3 and 5.

Sliding shift lever 52 rearwardly towards the shift actuating position 74 results in a corresponding longitudinally rearward linear travel of a first shift rack in the form of lower shift rack 158 which is pivotally attached to a rearward end of shift lever arm 104 by means of a pivot pin 160 and pin retainer clip 162. The lower shift rack 158 slides within gear cartridge 110 along corresponding inner guides (shown in section in FIG. 8) of the gear cartridge 110 and has upwardly-extending teeth 164 cooperable with a large diameter shift pinion 166 of a shift step-down pinion assembly designated generally by reference numeral 168. The shift step-down pinion assembly 168 is rotatably mounted on pinion pin 134 between bushings 137 and 170. The shift pinion assembly 168 includes a small diameter shift pinion 172 attached to the large diameter shift pinion 166 for rotation therewith on the pinion pin 134. The small diameter shift pinion 172 is cooperable with downwardly-extending teeth 174 of a second shift rack in the form of upper shift rack 176. The upper shift rack 176 slides along corresponding inner guides (shown in section in FIG. 8) of the gear cartridge 110 and is attached rearwardly to a proximate end portion 178 of a shift cable 180. The shift cable 180, like the brake cable 142, is also received and guided by the cable guide arrangement 144 out of the bar end 26. A remote end portion (not shown) of the shift cable 180 is attached to a downshift lever 181 (see FIG. 1) of the left Shimano XTR™ brake and shift lever unit 56 in the normal manner, which results in actuation of the downshift lever 181 when the shift cable 180 is tensioned.

Similar to the brake lever 50, the shift lever 52 can be slid rearwardly in the direction of arrow 177 towards the shift actuating position 74 to cause the shift cable 180 to be pulled into the bar end 26 in the direction of arrow 179, thereby tensioning the shift cable 180 and actuating the downshift lever 181 to downshift the front derailleur 36. The downshift lever 181 itself is normally biased towards a non-actuating position; thus, shifting can only occur when the shift cable 180 is tensioned by sliding the shift lever 52 to the actuating position.

As mentioned above and referring to FIG. 3, the handlebar attachment portion 60 is designed to receive an outer end of the left handlebar 30. The handlebar attachment portion has a generally cylindrical throughbore 182 forming part of the cavity of the bar end 26 having an axis 184 disposed generally transversely to the longitudinal axis 66 (FIG. 2) of the grip portion 58. The throughbore 182 is designed to receive co-axially and clamp onto an outer end of the left handlebar 30 (FIG. 1) using a bolt 186 to tighten the fit such that the grip portion 58 extends transversely to the handlebar 30.

As also mentioned above and with reference to FIGS. 3 and 4, the cable guide arrangement 144 receives and guides the brake and shift cables 142, 180 out of the bar end 26. The cable guide arrangement includes a pulley cartridge fitting designated generally by reference numeral 188 including a main cylindrical portion 206 which houses a brake cable pulley 190 and a shift cable pulley 192 rotatably mounted on a pulley pin 194 between respective bushings 196, 198, 200. The pulley pin 194 is retained in the pulley cartridge 188 by a pair of opposed radially inwardly directed retainers 202, 204.

Referring to FIG. 4, the main cylindrical portion 206 of the pulley cartridge fitting 188 fits into the outer end of the handlebar 30 (FIG. 1) through the throughbore 182 (FIG. 3) with radial projections 208, 210 received in complementary indentations in the outer surface of the handlebar attachment portion 60. A channeled extension 212 of the pulley cartridge fitting 188 rests inside a complementary groove of the handlebar attachment portion 60. The brake and shift cables 142, 180, from respective racks 138, 176, are guided through an opening 214 in the grip portion 58, and along the channeled extension 212 to the respective pulleys 190, 192, which receive and guide the cables 142, 180 out of the bar end 26 through and along the throughbore 182 (FIG. 3). Referring to FIG. 6, the brake and shift cables 142, 180 extend along a portion of a hollow interior of the left handlebar 30, exiting at separate locations spaced inwardly of the left bar end 26. The cables 142, 180 are then guided using conventional means to the front brake 32 and downshift lever 181 (FIG. 1), respectively.

Referring again to FIG. 3, an end cap 215 is used to cover an outer opening in the bar end 26 to protect components of the cable guide arrangement 144.

FIG. 8 illustrates the relative size of the pinions in each of the pinion assemblies 132, 168. The large pinion 130 of the brake step-down pinion assembly 132 is approximately twice the size of the small diameter brake pinion 136. In contrast, the large diameter shift pinion 166 is only approximately 1.2 times the size of the small diameter shift pinion 172. Thus, a greater mechanical advantage is conferred by the brake step-down pinion assembly 132 than the shift step-down pinion assembly 168. The absolute sizes of the pinions are selected so that forces which may be normally

generated by a cyclist's thumb are sufficient to tension the brake and shift cables 142, 180 enough to cause braking and down-shifting, respectively. In the case of the bicycle 20 (FIG. 1), more force is required to tension the brake cable 142 to effect braking than is required to tension the shift cable 180 to effect shifting.

Referring again to FIG. 1, the right actuator 42 is similar to the left actuator 44 and operates a downshift lever (not shown) of the right Shimano XTR™ brake and shift lever unit 54 which downshifts rear derailleur 38. The right actuator 42 also actuates rear brake 34. Since the components and mode of operation of the right actuator 42 are similar to that of the left actuator 44, the description of the left actuator 44, with obvious modifications, applies to the right actuator 42.

As can be seen in FIG. 6, the handlebars 28, 30 (FIG. 1) of the bicycle 20 include customized exits for the shift and brake cables 180, 142. The exits are formed by drilling a pair of axially-spaced holes in the handlebar 30. The shift and brake cables 180, 142 are fed through respective holes and inserted through respective customized hollow deformable plastic fittings 216, 218 through respective slots (not shown) in and extending the length of the fittings 216, 218. The fittings 216, 218 are then inserted through respective holes in the handlebar 30. Ends of respective shift and brake cable housings (not shown) are pushed into engagement with respective retainer portions 217, 219 of the fittings 216, 218. The shift and brake cables 180, 142 thus extend through the respective shift and brake cable housings (not shown) to the downshift lever 181 (FIG. 1) and front brake 32 (FIG. 1), respectively.

The invention also provides actuators which may be mounted to existing handlebars having no exit openings. An example is an actuator designated generally by reference numeral 220 according to a second preferred embodiment of the invention incorporated into a left bar end 221 and shown in FIG. 9. The actuator 220 is similar to the actuator 44 of the first preferred embodiment in every respect, except for the following.

The actuator includes a cable guide arrangement which receives and guides brake and shift cables 222, 224 out of the bar end 221 through respective openings 226, 228 in the bar end 221 spaced from a throughbore 230 of a handlebar attachment portion 232. The cable guide arrangement includes a brake cable pulley 234 and a shift cable pulley 236 mounted within a modified cartridge 238 (shown partially) in a grip portion 240 of the left bar end 221. The brake and shift cable pulleys 234, 236 are rotatably mounted on a pulley pin 242 between bushings 244, 246, 248. The pulley pin 242, in turn, is retained in slots 250, 252 of cartridge 238.

As can be seen with reference to FIGS. 9 to 11, the brake and shift pulleys 234, 236 receive and guide the respective brake and shift cables 222, 224 out of the bar end through the respective openings 226, 228. The cables 222, 224 therefore run outside of and alongside a left handlebar 254. The cables 222, 224 are guided by conventional means to a front brake (not shown) and a downshift lever (not shown) of a left Shimano XTR™ shift and brake unit (also not shown), respectively as in the case of the first preferred embodiment described above.

Referring to FIGS. 9 and 11, the actuator 220 is mounted to an outer tubular portion 256 of the existing left handlebar 254 by fitting the outer tubular portion 256 through the throughbore 230 of the handlebar attachment portion 232. The fit is tightened using a bolt 258. An end cap 260 is used to cover an outer opening in the throughbore 230.

In the foregoing description of the first and second preferred embodiments of the invention, the shift and brake pulleys may be replaced with any other suitable guides for guiding the shift and brake cables out of the bar end. Further, the brake cable may be coupled to a brake using an adapter such as the adapter disclosed in U.S. Pat. No. 5,094,322 to Casillas (See FIG. 6*a* of the Casillas patent). Moreover, an actuator according to the invention may be coupled to a lever of a primary conventional brake mounted on a handlebar to actuate the lever, thereby actuating a brake.

A third preferred embodiment of a hydraulic actuator according to the invention is shown in FIG. 12 and designated generally by reference numeral 300. The actuator 300, incorporated into a left bar end 301, is adapted to form part of an open hydraulic braking system of a bicycle (not shown) including a conventional hydraulic front disc brake (not shown) to be actuated by the actuator 300. A similar actuator may be incorporated into a right bar end to actuate a hydraulic rear disc brake of the bicycle.

The bar end 301 includes a grip portion indicated generally at 302 formed integrally with a handlebar attachment portion indicated generally at 304. A single operating device in the form of a thumb-operated brake lever 306 is slidably mounted to the grip portion 302 for sliding between a brake neutral position at a forward end of the bar end 301 and a brake actuating position axially spaced from the neutral position towards a rearward end of the bar end 301. A transmission mechanism in the form of a conventional hydraulic master cylinder assembly designated generally by reference numeral 308 is received within a cavity of the grip portion 302 between inner and outer housing members 309, 312 which are secured together using bolts 311 *a–d*. The master cylinder assembly 308 is available from Hayes Brake Inc., whose business address is 5800 West Donges Bay Road, Maquon, Wis., USA, 53092. The master cylinder assembly 308 is coupled to the brake lever 306 and also to the front disc brake, functioning to actuate the front disc brake when the brake lever 306 is in the actuating position.

The brake lever 306, like the brake lever 50 of the first preferred embodiment, is dimensioned to slide longitudinally along a guide rail 310 affixed to an inner surface of an outer housing member 312 using screws 314, 316, 318. An end cap 320 is also affixed to the outer housing member 312 using a screw 322. The end cap 320 limits the forward travel of the brake lever 306 and also functions as a thumb rest while cycling.

A push rod 324 is pivotally attached at a forward end 326 thereof to the brake lever 306 and extends into the master cylinder assembly 308 through a deformable push rod seal 328 of the master cylinder assembly 308. The master cylinder assembly 308 has conventional components including a piston (not shown) slidable rearwardly in a cylinder body 330 containing brake fluid to displace brake fluid out of the master cylinder 308. The piston is coupled to a spring (also not shown) which biases the piston forwardly within the cylinder body 330.

The push rod 324 engages the piston inside the cylinder body 330 and displaces the piston rearwardly when the brake lever 306 is slid to the actuating position, thereby displacing brake fluid out of the master cylinder 308. This, in turn, causes a displacement of brake fluid along a fluid path extending from the cylinder body 330 to the front disc brake.

The fluid path extends through a bypass end cap 332 having a tubular threaded connector 334 received inside a complementary threaded bore 336 of the cylinder body 330.

The fluid path continues into a hose 338 connected to the bypass end cap 332 using a hose nut 340 and a compression sleeve 342. The hose 338 has a remote end portion (not shown) connected to the front disc brake in the conventional manner, and the fluid path extends to the front disc brake through the hose 338.

Thus, sliding the brake lever 306 to the actuating position actuates the hydraulic front disc brake. Upon release of the brake lever 306, the return spring inside the cylinder body 330 biases the piston and therefore the brake lever 306 back to the brake neutral position.

The master cylinder assembly 308 is equipped with a bladder 344 for retaining excess brake fluid flowing out of the open cylinder body 330 via openings (not shown) in the cylinder body 330. The push rod seal 328 has an inwardly directed lip 345 which fits over a first flange 347 of the cylinder body 330 and resides between the first flange 347 and a second flange 349. The bladder retainer 344 has a forward end engaging a rearward end of the bladder retainer cap 346 to form a two-piece unit which slides over the cylinder 330 with a forward portion of the bladder retainer cap 346 engaging a rearward surface portion of the second flange 349. The bladder retainer cap 346 includes a fluid passage (not shown) through which brake fluid and air in the open hydraulic system may escape. A bleed screw 348 and rubber washer 350 are used to selectively open or close the fluid passage to a flow of fluid therethrough.

Referring to FIG. 13, a fourth embodiment of an actuator according to the invention for actuating a front derailleur of a bicycle and designated generally by reference numeral 400 is shown. Again, the actuator 400 is incorporated into a left bar end designated generally by reference numeral 402. A similar actuator may be incorporated into a right bar end to activate a rear derailleur of the bicycle.

Referring to FIGS. 13 and 14, the actuator includes an upshift operating device 404 for actuating an upshift lever 406 of a modified Shimano XTR™ shifter designated generally by reference numeral 408. A downshift operating device 410 is used to actuate a downshift lever 412 of the shifter 408. Each of the operating devices 404, 410 is slidable along a guide rail 414 which is secured to an outer housing member 416 of the bar end 402, using screws 418, 420. The connection is reinforced by a screw 422 which extends through an end cap 424, the guide rail 414, and a screw receiver 426, thereby securing the end cap 424 and the guide rail 414 to the outer housing member 416.

The operating devices 404, 410 are slidable between respective neutral positions at a forward end of the bar end 402 and respective actuating positions axially spaced rearwardly from the neutral positions.

An upshift transmission mechanism indicated generally at 428 and a downshift transmission mechanism indicated generally at 430 are received within a cavity of the bar end 402 and coupled to respective operating devices 404, 410, as will be described. The transmission mechanisms 428, 430 are also coupled to respective upshift and downshift levers 406, 412 and are adapted to actuate the levers 406, 412 when the operating devices 404, 410 are in the actuating positions.

The upshift transmission mechanism 428 and means of coupling the upshift transmission mechanism to the upshift lever 406 is similar to the downshift transmission mechanism 430 and means of coupling the downshift transmission mechanism 430 to the downshift lever 412, respectively. Thus, only the former will be described in detail.

The upshift operating device 404 includes a flexible, rearwardly-extending lever arm 434 to which is secured a slider in the form of a push rod 436 of the upshift transmission mechanism 428. The push rod 436 is thus slidable longitudinally with the upshift operating device 404, being disposed at a first position when the operating device 404 is in the neutral position, and being displaceable longitudinally rearwardly towards a second position intermediate the first position and a rearward end of the bar end 402 when the operating device 404 is in the actuating position. The push rod is slidable between the first and second positions within a slider receiver in the form of a push rod cylinder 438. A biasing member in the form of a return spring 440 is disposed within the push rod cylinder 438 and has a forward end engaging a rearward side of a bearing flange 444 of the push rod 436, and a rearward end 446 engaging a rearward inner shoulder (not shown) of the push rod cylinder 438. The return spring 440 acts to bias the push rod 436 towards the first position.

Forward travel of the push rod 436 is limited by an abutment ring 448 secured by screw threads within the push rod cylinder 438. The return spring 440 biases the push rod 436 forwardly until a forward side of the bearing flange 444 engages the abutment ring 448 within the push rod cylinder 438.

A mounting flange 450 is secured by screw threads to an outer surface of a forward end of the push rod cylinder 438. The mounting flange 450 is used to secure the upshift transmission mechanism 428 in place within a grip portion 454 of the bar end 402, being mounted to a complementary receiver 452 formed integrally with an inner surface of the outer housing member 416.

An upshift operating member in the form of a rigid push wire 456 is located outside of the bar end 402 and coupled to the push rod 436 by way of a small-coiled translation spring 458, as will be described.

Referring to FIGS. 13 and 14, the push wire 456 is contained in a tubular rigid push wire housing 460 with a remote end 462 of the push wire 456 seated in a complementary groove (not shown) provided in the upshift lever 406 of the shifter 408. The push wire 456 is slidable out of the push wire housing 460 to depress the upshift lever 406 thereby upshifting the front derailleur. The push wire housing 460 has a proximate portion 464 dimensioned to fit in a complementary retaining bore of a bored extension 466 such that rotation of the push wire housing about a longitudinal axis thereof is prohibited. Further, the retaining bore is dimensioned to prevent the push wire housing 460 from moving towards the upshift lever 406. The push wire housing 460 is also prevented from sliding away from the upshift lever 406 through the bore of the bored extension 466 by a clip 468 which is clamped around an indented periphery of the push wire housing 410 adjacent to the proximate portion 464.

A flanged tubular coupling 470 couples the push wire housing 460 to a flexible spring housing 472. A remote end 476 of the spring housing bears against a flange 474 of the flanged coupling 470.

The spring housing 472 extends from the remote end 476 thereof into a left handlebar through an opening in the left handlebar, into a throughbore 478 of a handlebar attachment portion of the bar end 402 designated generally by reference numeral 480, through a grooved outer channel (not shown) of the bar end 402, and into the grip portion 454, where a proximate end 482 of the spring housing 472 is pushed onto and in engagement with a reduced diameter rearward cylindrical portion 484 of the push rod cylinder 438.

Extending through the full length of the flexible spring housing 472 is a large coiled bearing spring 486 having a

proximate end 488 secured to an inner wall of the cylindrical portion 484 and a remote end 490 secured to an inner wall of the flanged tubular coupling 470. The bearing spring 486 acts as a bearing for the smaller coiled translation spring 458 which extends from the push rod 436 through the bearing spring 486, through the flanged tubular coupling 470, and to the push wire 456. The translation spring has a proximate end 492 which fits into a grooved rearward end 494 of the push rod 436 and a remote end 496 which fits into a grooved proximate end 498 of the push wire 456.

Thus, sliding the upshift operating device 404 to the actuating position causes an axially-rearward displacement of the push rod 436 within the push rod cylinder 438. The translation spring 458 is correspondingly displaced through the housings 472, 460, to push the push wire 456 out of the push wire housing 460 thereby depressing the upshift lever 406 to upshift the front derailleur.

The downshift operating device 410 is similarly coupled to the downshift lever 412. The downshift operating device 410 has a downshift lever arm 500 which is pivotally attached to a corresponding push rod 502 using a pin 504 and pin retaining clip 506. Sliding the downshift lever 410 rearwardly to the actuating position displaces the attached push rod 502 rearwardly to displace a translation spring (not shown) which, in turn, pushes a rigid push wire (not shown) out of a push wire housing 508, thereby actuating downshift lever 412.

In the case of both operating devices 404, 410, release of the operating devices from the respective actuating positions results in their return to the respective neutral positions under the action of the respective return springs in the respective push rod cylinders.

As in the case of the other embodiments, the downshift and upshift transmission mechanisms 430, 428 are housed in a hollow cavity of the bar end 402 between the outer housing member 416 and an inner housing member 510 secured to the housing member using a bolt 512. Similarly, the handlebar attachment portion 480 clamps onto an outer tubular end of a left handlebar, the fit being tightened using a tightening bolt 514. An end cap 516 is used to cover an outer opening in the bar end 402 to protect the inner components of the actuator 400 against damage.

While the actuators have been described as being incorporated into elongate members in the form of bar ends which are attached to outer ends of handlebars and which extend forwardly of the handlebars, it should be understood that the invention provides an actuator incorporated into an elongate member which may form any part of a handlebar system, which part provides an alternative grip position to a first grip position at which conventional brake and/or shift levers are mounted. For example, an actuator according to the invention may be incorporated into a bar end which is integrally formed with a handlebar. Further, the bar end may extend upwardly from the handlebar or curve forwardly and then inwardly so as to include a portion which is parallel to an adjoined handlebar. Thus, it is not intended to limit the invention to the particular structure of the handlebar system described herein.

The foregoing description is by way of example only and is not intended to limit the scope of the invention as defined by the appended claims.

What is claimed is:

1. An actuator for actuating a cycle speed change member, said speed change member consisting of one of a derailleur and a brake, said actuator being incorporated into a generally cylindrical elongate member adapted to form part of a cycle handlebar system, said elongate member having a cavity, first and second ends, and a longitudinal axis extending between said first and second ends, said actuator including

an operating device slidably mounted to said elongate member for sliding between a neutral position and an actuating position axially spaced from said neutral position;

a transmission mechanism received within said cavity of said elongate member and coupled to said operating device, said transmission mechanism being adapted to be coupled to said speed change member and to actuate said speed change member when said operating device is in said actuating position; and

a speed control cable having a proximate end portion coupled to said transmission mechanism and a remote end portion outside said elongate member adapted to be coupled to said speed change member;

wherein said transmission mechanism is adapted to pull said speed control cable into said cavity of said elongate member when said operating device is in said actuating position, said transmission mechanism including a rack and pinion assembly having a first rack coupled to said operating device, a pinion system cooperable with said first rack, and a second rack cooperable with said pinion system, said second rack being coupled to said speed control cable.

2. An actuator according to claim 1 wherein said elongate member is a bar end having

a grip portion including said first end;

a handlebar attachment portion including said second end, said handlebar attachment portion being coupled to said grip portion and having a generally cylindrical throughbore, said throughbore having an axis disposed transversely to said longitudinal axis, said handlebar attachment portion being thereby adapted to co-axially receive an outer end of a handlebar of a cycle such that said grip portion extends transversely to said handlebar; and

a cable guide arrangement for receiving and guiding said speed control cable out of said bar end.

3. An actuator according to claim 2 wherein said cable guide arrangement includes a pulley mounted within said throughbore, said pulley receiving and guiding said speed control cable out of said bar end through and along said throughbore.

4. An actuator according to claim 2 wherein said cable guide arrangement includes a pulley mounted within said grip portion and an opening in said bar end spaced from said throughbore, said pulley receiving and guiding said speed control cable out of said bar end through said opening.

5. An actuator according to claim 2 wherein said operating device is a thumb lever to be slidably displaced by a thumb of a rider.

6. An actuator according to claim 5 wherein said neutral position is at said first end.

7. An actuator according to claim 6 further including a biasing member coupled to said operating device for biasing said operating device towards said neutral position.

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